Natural Science

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NOTES AND COMMENTS.

Endowment of Research.

It has been held by many that the scanty endowment of research in Great Britain is the main reason why we fail to produce so large and useful an output of original work as emanates from some other countries. In a few years' time we shall have an opportunity of estimating the justice of this contention in the case of at least one branch of experimental science. Lord Iveagh's princely gift of a quarter of a million sterling to the Jenner Institute of Preventive Medicine should afford a crucial test of what endowment, on a truly munificent scale, can effect. Most of the workers in Preventive Medicine have been, and are, men engaged in professional occupations, and unable to devote themselves exclusively to research. With the funds now at the command of the Jenner Institute, there should be little difficulty in furnishing a capable band of workers with incomes sufficient to free them from the restrictions imposed by ordinary practice. Preventive medicine is a young and rapidly growing branch of science, and there is no subject in which greater advances may be anticipated in the near future. The results which should be brought about by a wise use of Lord Iveagh's gift ought to place the Jenner Institute at least on the scientific level of the Institut Pasteur, and the value of the work done should form so convincing an argument in favour of the endowment of research that other wealthy men would be tempted to follow his generous and public-spirited example. Everything depends on how the money is spent. The Council of the Jenner Institute includes a number of very eminent scientific men whose very names seem to afford a guarantee that its new-found wealth will be wisely and rightly applied. Hitherto the Institute has not been too amply provided with funds, and it has added to its income by a system of lectures and classes in Public Health and Bacteriology similar to those carried on at most of the larger medical schools in London, and for which approximately similar fees were charged. It would appear to us a very unfair thing that any of Lord Iveagh's money should be employed in subsidising this branch of the work of the Jenner Institute to the detriment of existing teaching bodies. We have before us the

Syllabus of the Institute for 1899, printed, doubtless, in ignorance of the financial prosperity that lay before it. We have also before us the scale of charges of the Investigation Department, framed on lines somewhat similar to those of the Clinical Research Association. It will clearly henceforth be beneath the dignity of an institution with an endowment of £250,000, to test the sputum for tubercle bacilli for a remuneration of five shillings, or even to offer a complete chemical and bacteriological report on a sample of water for a similar number of guineas. This may be left to those who have to work for their livelihood. The Jenner Institute has now before it a magnificent and unique opportunity for showing what can be accomplished in scientific results where "money is not so much an object as a comfortable home."

Economic Entomology.

"THE Report of the Proceedings of the Tenth Annual Meeting of the Association of Economic Entomologists" (1898) contains contributions under the names of many well-known American entomologists.

Two different entomologists write on the San José, or Pernicious Scale, an insect which certainly beats the record for literature on a single form, for legislation directed against the pest, and for money spent in combating its ravages.

In the experiments directed against the San José Scale, the feature of the year, as mentioned in the report before us, has been the use of pure paraffin with effective result against the Scale, and often no consequent, or at least permanent, harm to the tree. While most of the experimenters reported favourably, one or two cases were brought forward where sprayed plants were killed, and, so far as experiment has gone, the position may be summed up thus:—(1) Pure kerosene must always be used with great care; (2) it should not be used against young plants or tender fruit-trees; (3) hardier fruit-trees may be sprayed with pure kerosene, but the trees must not be drenched; the spraying should be carried out while the trees are in a dormant state; the day chosen for the spraying should be a bright one, with weather conditions favouring evaporation; (4) in case of recommendation to spray with pure kerosene, "the individual fruit-grower should be advised to experiment in a small way, and so determine for himself in his own locality, and under the local conditions that exist, whether he can use kerosene to advantage."

The caterpillars of the gipsy-moth (*Porthetria dispar*), as told in the report, continue their work of defoliation in the State of Massachusetts. Less than thirty years ago a few moths of this species, introduced into America by a naturalist for indoor experiment, accidentally escaped. In twelve years' time the descendants of these were

numerous enough to cause a plague. The continued spread and destruction caused by the pest attracted the attention of the State Legislature in 1890, which voted 25,000 dollars for exterminative work. This work continues to be prosecuted diligently, and with the last year's grant of 200,000 dollars and expected aid for the next year or two, the Commission appointed hope to exterminate the pest.

This moth has a bad reputation on the Continent for damage to forests, but in England it is said to be rapidly disappearing, being no longer found in localities where some time ago there was no difficulty in procuring specimens.

Mosquitoes and how to get rid of them forms the subject of another article in the report. Some time ago a paragraph went the round of the newspapers stating, among other things, that permanganate of potash in very dilute solution was fatal to mosquitoes in all stages of their life. One part of permanganate in 1500 of solution was said to render the development of the larvae impossible, while a handful thrown into a ten-acre swamp was said to be sufficient to kill the larvae and keep the swamp clear of mosquitoes for a month, and all this at a cost of only twenty-five cents. Although other statements in the paragraph suggested the unreliability and worthlessness of the whole, Dr. Howard, of the Entomological Department in the United States, who was investigating the mosquito problem at the time, made some experiments with permanganate of potash of various strengths, and found that small amounts had no effect whatever against the pest. As a matter of fact, a waggon-load of permanganate would be required to kill in a ten-acre swamp, and as the water at the end of twenty-four hours is in a condition fit to support mosquito life again, the treatment would require to be repeated every two days. Experiments continue to be made under Dr. Howard's direction, paraffin being allowed to cover the surface of the water in marshy places during the mosquito breeding-season. The botanist, however, has complained on the score that the oil was very destructive to water plants.

An interesting little sermon, entitled "Entomological Ethics," was preached by Mr. T. D. A. Cockerell, who, among other matters, discoursed on the question of private ownership and State property in connection with the materials sent for examination to the various State departments, from the text of St. Paul to the Romans, "What then? Shall we sin because we are not under law, but under grace? God forbid!"

Great Auks in Ireland.

THE *Irish Naturalist* for January contains two short papers on the occurrence of the Great Auk in the North and South of Ireland, by Messrs. R. J. Ussher and W. J. Knowles.

Mr. Ussher's hunting-grounds were the kitchen-middens of the South of Ireland, previously visited by him. The bones which he discovered on this occasion represented portions of the pectoral and pelvic limbs, and a fragment of a left innominate bone. These were found associated with the remains of "domestic animals and fowls (*sic*) . . . Red-deer, . . . burned stones, and charcoal in layers, and great quantities of shells of edible species (*sic*)." The latter half of the paper contains some extracts from a very sensational article by Lady Blake which appeared in the *Victoria Quarterly* for August 1889. The genuineness of these stories, though no doubt published by Lady Blake in all good faith, is seriously open to question. So far, there seems to be not a tittle of evidence in support of any of the statements therein set down.

Mr. Knowles's finds were made in the North of Ireland—Whitepark Bay. These represent portions of the fore and hind limbs and of the pectoral girdle. "The first remains of Great Auk" from Whitepark Bay were, he tells us, "obtained during a careful excavation of a portion of the black layer,"—information of questionable value, inasmuch as he omits to inform us to what period the "black layer" belongs. Just as, in an earlier part of his paper, he tells us that "There were also associated with these remains flint flakes, cores, hammer-stones, and flint scrapers, together with edible molluscs" (*sic*).

We are curious to know the nature of the "physiological preparations" of the Great Auk, referred to in Mr. Knowles's paper. These two papers are illustrated by some rough and somewhat inaccurate sketches, signed by "M. Knowles."

About Yeast.

MORE than a year ago we were startled by the announcement of the discovery, by Dr. Buchner, that the alcoholic fermentation set up by the yeast-plant was due to an enzyme or ferment which he had succeeded in extracting from it. This meant that a long-cherished belief that the action of yeast could not be disassociated from the living plant must be given up, and the process of fermentation be regarded as simply one of a long series of ferment-actions comparable with that of diastase on starch or pepsin on proteid. However, we were reassured by Prof. Reynolds Green, who, in a paper published in the *Annals of Botany* at the end of 1897, stated that he had been unable to extract an alcohol-producing enzyme from yeast. But, alas! for our equanimity! The latest number of the same journal (vol. xii. p. 491) contains another paper by Prof. Green, who has repeated his experiments with special precautions, and is now driven to the conclusion that actively-fermenting yeast-cells do secrete an alcohol-producing

enzyme which can be extracted by appropriate means, and will set up fermentation in sugar-solutions under conditions which preclude any activity of living plant-cells. The process was a perfectly normal one, accompanied by the diminution of the sugar, the production of carbonic acid gas, and the formation of alcohol. The enzyme is easily decomposed, and therefore rapid manipulation during the process of extraction is necessary. The secretion is shown to be intermittent, occurring only during actual fermentation, and as the enzyme is soon decomposed when the activity ceases, it is not found in the resting state of the plant. Owing to these peculiarities Prof. Green failed to extract any of the ferment in his former experiments. Dr. Buchner obtained the enzyme by subjecting the yeast to high pressures applied by an hydraulic press, but Prof. Green finds one of five atmospheres quite sufficient.

In the same number of the *Annals* Mr. Wager supplies an interesting addition to our knowledge of the cytology of the yeast-plant. The presence or absence of a nucleus has been matter of considerable dispute. While such a structure has been described by many observers, others have declared the so-called nucleus to be merely a mass of proteid or a vacuole. Mr. Wager has made several contributions to the literature of the subject, speaking for the nucleus, but the one just published seems to put the matter beyond doubt. He describes—and his paper is accompanied by a large series of excellent figures—a structure which he states is invariably present in the cells, and which is a perfectly homogeneous body resembling a nucleolus rather than the nucleus of the ordinary plant-cell. In the earlier stages of fermentation this nucleolus is in close contact with a vacuole which contains a granular chromatin-network, and shows a structure in many cases like the chromatin-network of the nuclei of higher plants. In the later stages of fermentation the chromatin-vacuole may disappear, its place being taken by a granular network or a number of chromatin-granules which may be disseminated through the protoplasm or grouped around the nucleolus. Numerous vacuoles are often found in young cells; these apparently fuse to form the single vacuole already described. In the process of budding, the division of the nuclear apparatus does not show any definite stages of karyokinesis, but is to be regarded as a direct division of the nucleolus into two equal or nearly equal parts, accompanied by division of the chromatin-vacuole or network. In spore formation the chromatin disseminated through the protoplasm becomes more or less completely absorbed into the nucleolus which then divides.

One feature of Mr. Wager's work is the cutting of microtome sections of yeast-cells after imbedding and hardening in paraffin. The absence of karyokinetic stages in the division of the nuclear apparatus will perhaps still leave room for doubt in the minds of some cytologists as to the true nuclear character of the structures described.

Systematic Position of Phoronidea.

PROFESSOR L. ROULE has published a short paper (*Comptes rendus ac. sci., Paris,* Oct. 1898) upon the above subject. He has followed the development of *Phoronis sabatieri,* and has been led to suggest one more possible origin for the Vertebrata.

He accepts Mr. Masterman's conclusions with regard to the systematic position of *Phoronis,* in that he considers its nearest affinities to be with the so-called "Bryozoa Pterobranches" (or in other words, *Cephalodiscus* and *Rhabdopleura*) and holds that the Chordata may be directly traced through *Actinotrocha.* He is led to this mainly by accepting the homology of Masterman's so-called "notochords" with the similarly-named organ in the Chordata, confirming this author's description of their origin and histological structure.

On the other hand, he finds in *P. sabatieri,* that the "notochord" is unpaired and ventral, instead of paired and lateral. In the species investigated by Masterman the pleurochords are strictly lateral, though the fact that the "oesophagus" enters the pharynx at its antero-dorsal corner gives them a position apparently ventral to the pharynx. Dr. Roule does not furnish any figures, so that one cannot say whether this fact has any bearing upon his conclusions, and in any case the unpaired condition is a remarkable difference in so closely allied a species.

Still more remarkable is the conclusion to which the author is led by these facts. *Actinotrocha* has a ventral notochord, the vertebrate has a dorsal one; what more natural than to turn the former upside down?

Professor Roule reverts to the idea that *Actinotrocha* is a trochophore (in spite of its five coelomic cavities described by Masterman to which he makes no allusion), and hence he speaks of the "notocorde de ces Trochophores," and the old conclusion is eventually reached that "le Vertebré est un Annélide retourné." The author must not, however, be understood to revert to anything so commonplace as the now well-known morphological somersault of the annelid aspiring to Chordate structure. The *Actinotrocha,* already inverted in the pursuit of progress, turns itself horizontally through 180°. Its mouth then becomes the vertebrate neurenteric canal, and its anal extremity becomes moulded into the head of the Vertebrate. Truly there is a divinity that shapes our ends, invert them how we may! Professor Roule's theory of vertebrate origin will doubtless compare favourably with the various speculations centering round the king-crabs, spiders, leeches, and worms from which we are invited to trace our lineage.

Prickly-Pears on the War-Path.

THE remarkable productiveness exhibited by certain organisms when artificially introduced into new territory outside the area of their distribution, and where they are freed from those natural checks, under the restraining influence of which their protective armour and weapons of offence have gradually arisen, illustrates in a remarkable manner the intensity of the struggle for existence, and is therefore of perennial interest to others besides those directly affected by it.

It is perhaps not to be wondered at that such species are usually if not always objectionable, and it falls to our lot to call attention to one more instance of the harmful nature of such invasions. In a "Preliminary Study of the Prickly-Pears naturalised in New South Wales," Mr. J. H. Maidan, the Director of the Sydney Botanic Garden, supplies us with detailed descriptions, accompanied by numerous photograms of some six or seven species of *Opuntia*, which, originally introduced into the colony in 1789 in connection with the cochineal industry, have escaped from cultivation, and already cover large areas of fertile land with impenetrable entanglements of thorn. The Colonial Government has been compelled to interfere with an Act for the eradication of the pest, but the expulsion of species which are only amenable to the arguments of fire or poison, and possess a hydra-like vitality, in that every minute fragment gives rise to a new individual, promises to be a task of no small difficulty. It is a relief to know that the Opuntias have some redeeming characters, for every one who knows the plants will agree with Mr. Maidan in recognising their desirability from a horticultural point of view. Some species bear edible fruits; others may be employed to form cattle-proof fences, and certain thornless varieties may even be used as fodder plants.

"Terminologic Transgressions."

"WHAT'S in a name"? is no doubt a question which has been repeated by many since the day of which we first have record. It is not the members of the Rosaceae alone which have been supposed to smell as sweet by another name. If there be among our readers any who thus dally carelessly with the sacred instrument of thought, let them now be warned, for a day of reckoning is at hand, and their sins shall surely find them out. Let them be warned, we say, for the Chairman of the "Committee on Neuronymy of the American Neurological Association" is abroad, and who shall stay his hand? Hidden under the modest title of "Some Neural Terms" within the covers of "Biological Lectures delivered at Wood's Holl Laboratory during 1896-97," we have from the pen of Professor Burt G. Wilder a sweeping indictment

of modern anatomists. Huxley, who is known to his fellow-countrymen for some other achievements, is here immortalised as guilty alike of "Direct Pecilonymy" and of "Pecilonymy by Permutation." Others, whose names are as yet concealed, are guilty of "Perissology," of "Magnilogy, which is the same as Anatomic Esotery," of the use of "Polychrestic terms," of indifference to the "Paronymic advantages of Mononyms"; nay, worst of all, of "attempting to check terminologic progress by ridicule." From which and all other "verbifactive sins" may we and our readers be delivered! But to those who, blinded by ignorance, refuse to accept forthwith Mr. Wilder's nomenclature, one other argument may be addressed. Be it known, that it is they and they alone who prevent the coming of that millennium when "*every child of ten* shall have a somewhat extended personal acquaintance with the gross anatomy of the mammalian brain." Those whom this argument fails to convince are beyond hope.

Into the details of Professor Wilder's nomenclature we cannot enter here; no doubt we have said enough to induce our readers to seek it at the fountain-head, but one point we cannot pass unnoticed. It is proposed to avoid the use of proper names in terminology, save where these are recommended by their peculiar euphony. Of such "euphonious" names "Johnny M'Whorter" is given as an example. Deep as is our sympathy with the author's aims, we cannot but feel that there is something invidious in this mention of a single example. Those of us who have a standard of euphony which is different, will find some difficulty in deciding exactly what proper names are legitimate; in determining whether it is the affectionate modification of the first name, the prefix of the second, or the fine full sound of its penultimate syllable, which to the Professor's ear imparts the special charm to the example. A list of suitable names would, we think, be a valuable addition to the next paper.

Early Life on Earth.

CAPTAIN F. W. HUTTON's presidential address to the Geological Section of the Australasian Association for the Advancement of Science has at last reached this country in its printed form. It deals with "Early Life on Earth," and gives a short account of the oldest known fossils. *Eozoon* is rejected from the organic world, while the limestone and graphitic beds of the Grenville series of Canada do not appeal to Captain Hutton as evidence for contemporary life; they may, he thinks, have been due to the decomposition of calcium carbides by hot water. The radiolarian and sponge spicules found by C. Barrois and L. Cayeux in the Archaean rocks of Brittany are regarded as the earliest undoubted traces of life, but necessarily indicate the existence of organised protoplasm at a far earlier period.

There is not much professedly original in the address; but when most people are trying to overcome difficulties by postulating a more rapid rate of variation in the early stages of organic life on earth, it is interesting to find Captain Hutton believing in a slower rate of variation at that period. He bases this Antipodean view on the great thickness of Archaean and early Palaeozoic rocks, and considers that the representation of all the sub-kingdoms of animals in fossils of Cambrian, or at all events of Ordovician age does not imply so great an amount of evolution as do the subsequent developments. "It was this slow rate of variation in ancient times that enabled the early Palaeozoic genera to spread so much more widely over the earth than do the genera of the present day." It must not, however, be forgotten that some would ascribe the great relative thickness of early sediments to greater intensity of denudation on an earth unprotected by vegetation.

The Passing of the Vanquished.

THE extinction of whole groups of animals, as of the graptolites in the Carboniferous period, and the trilobites in the Permian, has always been a puzzle to naturalists, and on this Captain Hutton has some suggestive remarks. The existence in early times of Radiolaria, almost identical in structure with their descendants of the present day, suggests to him, in opposition to the views of H. S. Williams, "that there is no inherent necessity for organisms to vary or decay, while the idea that if they vary then they must subsequently decay is opposed to the whole teaching of organic evolution, for it is the variable groups which have progressed." The extinction of a whole group must therefore be due to external agencies, and if the group was widely spread, these cannot have been local in their operation.

Change of climate may, perhaps, sometimes account for the extermination of a group of terrestrial animals or plants, but it cannot greatly have affected those living in the sea. "The struggle for existence with other animals has, no doubt, generally been the most efficient cause of extinction, and with pelagic animals it is probably the only cause." The graptolites can hardly have succumbed to want of food, but probably served as food for others. Those others may have been medusae or pelagic cephalopods. Captain Hutton favours the latter, but admits that we know very little about them. The trilobites, on the other hand, were, he thinks, preyed upon by the ground cephalopods, which increased in numbers as the trilobites decreased. In vain the latter acquired the power of rolling up into a ball: "the ruthless intruders turned them over and tore out their insides."

We have unrolled Captain Hutton's pamphlet, turned it over and torn out its inside for our readers. But we hope that the gallant author will not become extinct just yet.

The Functions of Marine Stations.

WHAT are the functions of a local Marine Station? The question is suggested by the perusal of the "Twelfth Annual Report of the Liverpool Marine Biology Committee," which has just reached us. It contains not only a general account of the work of the Port Erin Station during the past year, but a stirring address by Prof. Herdman on some proposed extensions of its work. Some twelve years ago the Liverpool Committee began the investigation of the marine life of the bay; since that time their sphere of operations has gradually extended, as the members have plunged more and more deeply into the work, and now we have an eloquent protest from Prof. Herdman against artificial geographical limitations, and an appeal for means to carry on work on a more elaborate scale. The problems of distribution, which in their local aspect were one of the prime objects of the Committee's investigation, prove to be insoluble unless attacked on a large scale. The migration of food-fishes, again primarily a local question, is intimately bound up with the plankton-bearing currents of the open seas, and it is in these open seas, and not merely in local waters, that investigation must be carried on. So it is with the other problems which have forced themselves on the notice of the workers at the station. Prof. Herdman therefore appeals, in the first place, for a British Prince of Monaco, whose yacht may enable the Committee to carry out an extensive series of observations in the open sea, and also for funds to improve the station, and carry out adequately the publication of a series of memoirs on common marine animals—another scheme at present in contemplation. We sincerely trust that this appeal to the merchant princes of Liverpool will not be in vain, and that they will hasten to wipe away the reproach of their apathy as contrasted with the liberality with which wealthy Americans so often endow science. We cannot, indeed, but regard it as remarkable that a wealthy city like Liverpool, with all its traditions as a seaport, should be unable to offer its Marine Station more than the very small sum at present at its disposal. If successful and persevering work with small means deserves encouragement, it certainly should not be lacking to the Port Erin Station. We wish Prof. Herdman and his colleagues all success in the carrying out of their enlarged conception of local research.

Salt-developed Succulence

HALOPHYTES we have always with us, and also the problem of the causes underlying the succulent xerophytic structure so characteristic of this group of almost aquatic plants. The opinion usually held has been to the effect that the saline character of the water rendered its

absorption by the plant a matter of considerable difficulty, that in short the conditions of life might be described in the well-known words "water, water, everywhere, but not a drop to drink."

Schimper's experiments ("Indo-malayische Strandflora") suggested that salt exercises a poisonous influence on plant life, and he concluded that structural adaptations directed towards the reduction of transpiration were brought about by the necessity of keeping the relative amount of salt in the cell sap below a certain point, which varies with the species.

Stahl (*Bot. Zeit.* 1894) pointed out from observations on artificial cultures that the stomata of Halophytes are completely paralysed, the apertures remaining permanently open, thus compelling the plant to take refuge in other structural modifications in order to limit the transpiration current; hence the succulence.

Professor Diels (*Pringsheim's Jahrb. f. Wiss. Bot.* xxxii. 1898) has been unable to discover in plants growing under natural conditions any stomatic paralysis such as that described by Stahl, and he also differs from Schimper in holding that the concentration of sodium chloride is kept below the danger point, not by limitation of transpiration, but by a chemical decomposition of the salt which at the specific limit of concentration balances the absorption. The process of respiration in succulents differs from that in other plants in that oxidation does not proceed quite so far, but stops at malic acid or some isomer with which the cell sap becomes saturated, while only small quantities of carbonic acid are evolved.

Professor Diels employs this inherent acidity of temper, only obtainable by the development of succulence, in decomposing the excess of sodium chloride, with the result that the plant is enabled to exist unharmed in the bitter waters of its Marah. The chemical process by which the decomposition of the salt is effected is not as yet known, but the author assumes that the malic acid combines with the sodium to form a salt which is of further use in the plant economy, while the hydrochloric acid is excreted by the roots.

Chalazogams

SINCE Treub first called attention to the chalazogamy of Casuarines (*Ann. Jard. Bot. Buitenzorg,* 1891) many examples of the non-micropylar growth of the pollen tube have been recorded, and the theory of the evolution of normal porogamic dicotyledons from the chalazogamic type has been steadily upheld by several botanists, among whom perhaps the best known is Professor Nawaschin.

In his most recent paper ("Ueber das Verhalten des Pollenschlauches bei der Ulme," *Bull. Acad. Sci. St. Petersbourg,* 1898)

Professor Nawaschin points out that the condition in the elm is transitional between the lower chalazogamic and the assumedly higher porogamic types.

The ovary of *Ulmus*, in common with that of the typically chalazogamic forms, is devoid of the conducting tissue so characteristic of those cases in which the nutrition of the pollen tube requires to be provided for in its passage across the ovarian cavity.

The ovule is of the pendulous inverted type, and in the great majority of cases the pollen tube reaches it by growing down through the tissue of the funicle not far from the surface till nearly opposite the middle of the ovule when it strikes across through the integuments, the outer of which is but slightly developed, to the apex of the nucellus, thus avoiding alike micropyle and chalaza. In rare cases the tube grows quite close to the surface of the funicle, in fact among the epidermal cells, and even exhibits a tendency to project into the surrounding cavity. These the author cites as indications of a reaching out toward a higher porogamic life. On the other hand, the tube sometimes enters the deeper tissues of the funicle and grows directly towards the chalaza, where however it is stopped by a patch of apparently cuticularised tissue. Here Professor Nawaschin sees a reversion toward the ancestral chalazogamic condition typically represented in Casuarineae, Betulineae, and Juglandeae. The extent to which differences of this kind are to be treated as supplying a basis for classification is at least a question open to discussion.

A Theory of Colour Vision.

BELIEVING that the problem of colour vision is "primarily a mechanical one," Dr. W. Patten, writing in the *American Naturalist* for November 1898, has given us a first instalment of an attempt to unravel the mechanism. His brief notice of the Young-Helmholtz theory is introduced by the words, "In Sir Isaac Newton's time there were supposed to be three sets of fibres in the retina!" Dr. Patten's mechanical theory is based upon his claim to have found in the rods of certain eyes—though not in those of the vertebrates—fine nerve fibrils which traverse the rod always at right angles to the direction of the light. As the light travels through the rods these fibrils are stimulated in some way by the ether waves. In cones these fibrils would naturally present regular diminishing scales, the longest at the base, and the shortest at the tip; the longest might, according to Dr. Patten, be stimulated by the longer red waves, the shortest by the violet waves. This is practically the whole theory, which rests upon the gradual variation in the *length* of the transverse fibrils if they could be shown to exist in cones. Passing over this stumbling-block,

that these necessary fibrils have never been discovered in human eyes which we know for certain have a scale of colour sensation, we would remind Dr. Patten that the little evidence which we have—however unsatisfactory we admit it to be—points rather to the tips of the rods or cones as being sensitive to red, and the bases to the violet, which is the reverse of what his theory demands. Nor again do we admit that "every one knows" that the nerve fibres are discontinuous, as taught among others by Ramon y Cajal. It is true that this doctrine has been very hastily accepted, but signs of reaction are not wanting.

One curious part of Dr. Patten's theory is that the optic ganglion, having in some animals (e.g. *Acilius*) a slight resemblance in shape to the retina, and its "Punct-substanz," and being composed of similar fine "vibrating" fibrils, forms with the retina an apparatus suggestive of "a Marconi transmitter and receiver"!

Adaptation.

UNDER the title "Zweckmässigkeit und Anpassung," Dr. J. W. Spengel has published, with Gustav Fischer of Jena, a recent academical address. In popular language adapted to a mixed audience, he here discusses one of the vexed problems of evolution. Finding plants and animals fitting perfectly into and reacting with their surroundings, like "ready-made machines dropped down from heaven," we have, alas! no certain answer to the question "how they came there." While admitting that we *must* use the word "adaptation," it is yet, to the author, one of these beautiful words which always pop up "wo Begriffe fehlen," as Goethe's Mephistopheles points out to encourage students of theology. Let us be clear then what we mean. Does "Adaptation" mean "adapted from without" or "adapting itself from within?" In very limited and quite unimportant matters the word may be admitted in both senses. But to show how inadequate these are to explain the facts, he gives a list of cases in which he contends neither would apply. One such case, for example, is the perfect fitness of the whale to its marine life in cold latitudes. In reference then to the essential mechanics of evolution the word adaptation does not mean a process but a fact. His "Anpassung" is therefore nothing more than his "Zweckmässigkeit," and he looks elsewhere for its explanation.

The best answer, he concludes, is that given by the "Natural Selection" of congenital variations. It may be doubted, however, whether Dr. Spengel's arguments against direct modification of structure in response to changes in the environment, and the gradual inheritance of these modifications, attain that degree of cogency which can be called convincing.

Bibliography of Zoology.

DR. H. H. FIELD, writing in the *American Naturalist* for December 1898, states that the work of the Concilium Bibliographicum, hitherto carried on with heavy pecuniary loss to himself, has now been made safe for the future by a permanent subsidy voted to it by the Swiss Confederation, the canton, and the town of Zurich. The office now has its own composing-room, where three type-setters and a head typographer are at work all day. Hard by it has its own large cylinder press, as well as a paper-cutting machine in charge of a special machinist. With this staff 100 cards a day can be turned out, and this is estimated to be more than double the actual rate of zoological publication. A separate staff is employed to sort and check the cards, and to distribute them to subscribers. The use of the classificatory numbers enables this to be done with an almost automatic precision. This system of numbers is a purely practical device for enabling the cards to be sorted at once into their assigned places by any one that can read Arabic numerals. For purposes of subscription almost any conceivable topic may be ordered, no matter how restricted it may be; the price varies from one-tenth of a penny to a halfpenny a card, according to the size of the order. These details refer to the zoological portion of the catalogue only; but the anatomical and physiological bibliographies are also in an advanced state of preparation, and will soon be supplied with regularity.

The Museum and Gardens of Trivandrum.

TRIVANDRUM, the capital of Travancore, in the extreme south of India, has a museum and public gardens. The director of these is Mr. Harold S. Ferguson, who recently gave two interesting lectures on these institutions. From the report published in the *Western Star* we learn that both were originated by Mr. J. A. Brown, who in 1852 was appointed astronomer at Trivandrum. This most enthusiastic worker, though strongly supported by the Resident, General Cullen, was unable to make much headway against the peculiar ideas of the native authorities. His successors, the botanist Colonel Heber Drury, Captain Drury, Major Davidson, and finally the chaplain, Mr. Pettigrew, were not more successful, though all, except Captain Drury, had correct ideas of what such a museum should be. In 1879 the management of the museum was placed in the hands of a committee of three, presided over by the British Resident, and, thanks chiefly to the honorary secretary, Colonel Ketchen, the whole establishment was reorganised. Mr. Ferguson himself joined the committee in 1880, and in 1886-87

spent his furlough in studying museums at home. The conclusions to which he then came were in accordance with the enlightened ideas of Sir William Flower, and were fully accepted by the committee. Mr. Ferguson was given full power to put his plans into effect so far as means permitted. In 1890 he succeeded Colonel Ketchen as secretary, and had charge of the Zoological and Public Gardens as well. In 1894 the committee was abolished, and Mr. Ferguson left in sole charge. He appears to have proved worthy of the trust placed in him.

The museum building, completed in 1880, is a beautiful one, though, like many fine buildings, not perfectly adapted to museum requirements. It consists of a main central hall, 70 feet by 40 feet, with walls 35 feet high. Two wings, each 45 feet by 20 feet, with walls 15 feet high, join this to two other rooms 50 by 30, with walls 25 feet high. The main hall is given up to the representation of Travancore arts, manufactures, archaeology, and ethnology. In the south hall are the invertebrates; the wing joining it to the central hall contains the reptiles and amphibians, and will eventually hold the fishes. The north wing is devoted to birds, and the north room to mammals. No space seems to be left for geology and botany, and these subjects, we are told, are but poorly represented. The exhibited systematic series of animals is naturally almost restricted to the fauna of Travancore; but in connection with each of the classes is, or will be, an introductory index series. Such a method of arrangement is, in our opinion, an improvement on the model, namely, the Natural History Museum in London. It permits more ready cross-reference and comparison.

The Zoological and Botanical Gardens, though sanctioned in 1859, were not begun in earnest till 1864. The work progressed steadily, though slowly, in the hands of Mr. Brown, Major Davidson, Mr. Pettigrew, and the committee mentioned above. The grounds generally were brought to their present satisfactory condition by Mr. Ingleby, who came from Kew in 1891 and remained as Superintendent till 1897. In 1867 various animals were transferred from the menagerie of the Maharajah. Better houses were subsequently built for the larger animals, on the basis of plans supplied by the Zoological Society of London. Among the animals now in the gardens, Mr. Ferguson mentions the following: The three kinds of monkeys found in Travancore; two lions, obtained from England; a nervous tiger; a pair of black leopards; a hyaena; various Travancore cats; so-called wild dogs; Himalayan and Indian bears; a great one-horned rhinoceros; a Malay tapir; all the Travancore deer; some Indian antelopes; several species of kangaroo and wallaby, which attracted people in thousands from all parts of the country when they first bred; emeus, cassowaries, an African crowned crane, and many other birds; two Hamadryad snakes; a python, which refused food for a year and ten days when it arrived eight years ago; and a large water

lizard, which is death on rats. Mr. Ferguson's lecture contains some interesting notes on these animals and on local superstitions attaching to them. Travancore is to be congratulated on its gardens and museum, and still more on having so capable a public servant as Mr. Ferguson.

The Transformations of an Earwig.

IN 1881 the late Prof. Westwood described, under the name *Dyscritina longisetosa*, an insect from Ceylon, with the head and body of an ordinary earwig, but with a pair of long jointed cercopods on the last abdominal segment instead of the usual forceps. Entomologists have long suspected that this curious insect would prove to be the immature stage of an earwig; this opinion has now received confirmation by the researches of Mr. E. E. Green. In the latest part of the *Transactions of the Entomological Society*, 1898, pp. 381-390, Mr. Green gives an account of the development which he has traced, and Mr. M. Burr contributes systematic notes on the two species of earwig which were reared from two distinct forms of *Dyscritina*. They are referable to the genus *Diplatys*, Serville.

The most remarkable feature in the development of these insects is the method of transformation of the long jointed cercopods into the forceps. In one of the species examined the cercopods are much longer than the insect's body, in the other somewhat shorter; but in both the basal segment of the cercopod is longer and stouter than the succeeding segments. At the last moult but one, all except the basal segments are completely shed; Mr. Green believes that the insects actually bite them off! Within the truncated cercopods the forceps of the adult can be clearly seen, and these are revealed at the final moult.

It is likely that other tropical earwigs will be found to undergo a similar change, contrasting strongly with our European species, which are hatched with simple tail-appendages already resembling the forceps of the adult. The observations of Mr. Green afford valuable support to the view that the forceps are modified cercopods, and indicate the affinity of earwigs to the Thysanura and Orthoptera, in which orders jointed tail-appendages are so characteristic a feature.

ORIGINAL COMMUNICATIONS.

Vegetable Animation.

By John H. Wilson, D.Sc., F.R.S.E.

Most people regard plants as stationary or still objects, exhibiting no movement unless such as is due to the action of the wind or other external agent. The light, quivering aspen leaves respond instantly to the faintest zephyr; the great shoulders of the hurricane are needed to sway the bole and boughs of the gnarled oak. Their oscillation does not startle anybody, because inanimate objects possessing elasticity are similarly affected by the air in motion.

Only the slightest reflection is needed to convince us that plants are seldom either quite stationary or quite still. If they are alive their vital activity will find expression in movement of some kind. A long list of instances could be given of parts and organs of plants exhibiting movement so slow as to be inappreciable to the unaided human vision, and yet quick enough to be recorded by instruments of rude construction. The poet tells us that—

> The sun-flower turns on her god, when he sets,
> The same look which she turn'd when he rose.

This phenomenon the botanist restates when he says that the capitulum of *Helianthus* exhibits heliotropism. A climbing stem swings slowly round in space, in an elliptical orbit of growth, until it touches some suitable support, and it thereupon winds itself in a tight spiral round the object. The glandular tentacle of the leaf of sundew bends, with unerring precision, over the captured prey.

If we desire records of violent spontaneous movement on the part of plants we must either turn to the pseudo-scientific literature of a credulous past or to the ultra-scientific vision of the poet. We find the bold delineation of the Tartarian Lamb, and note that "it has something like four feet, and its body is covered with a kind of down. Travellers report that it will suffer no vegetable to grow within a certain distance of its feat." We do not learn from the traveller's tale why this plant quadruped destroys the vegetation round

its "feat." It is a harmless creature compared with one we read of next:—

> Fierce in dread silence on the blasted heath
> Fell Upas sits, the Hydra-Tree of death.
> Lo! from one root, the envenom'd soil below,
> A thousand vegetative serpents grow;
> In shiny rays the scaly monster spreads
> O'er ten square leagues his far-diverging heads.

Although we must not expect to find anything so very sensational as this in our study of vegetable motility, it is not without its surprises. Who, on first seeing the Sensitive Plant shrink from touch, has not exclaimed, "How very wonderful!" or failed to follow up the ejaculation by the query, "How does this extraordinary movement take place?"

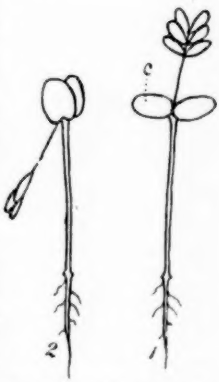
The sensitive plant most commonly grown in greenhouses is *Mimosa pudica*; other species, some of which are only slightly "sensitive," are seldomer seen. The common species is easily grown from seed which can be purchased, or gathered from plants which have flowered indoors. Like many of its congeners it performs the so-called sleep movements, closing up and lowering its leaves at night. During the day the leaves are spread out flat. If, then, a leaflet at the extremity of the divided leaf is touched lightly, in an instant the pair of leaves contiguous to it will flap upwards and meet, then the next pair, and the next, until the whole series approximate. If the stimulus is sufficiently strong, it will pass into the neighbouring secondary leaf-stalks, and not only cause the leaflets they bear to meet, but will induce the leaf-stalks themselves to come together, like the ribs of a fan when being folded up. It is quite possible, with caution, to cause one leaflet alone to move without affecting any of the others. When the stimulus has been severe, the folding up of the leaflets is followed by the drooping of the primary leaf-stalk. A rude shock causes the whole foliage of the plant to assume instantly a collapsed and dead appearance. It is a mistake to suppose that the approximation of the leaflets must take place before the fall of the hinged stalk. By gently pressing on the top of the stalk it can be made to descend without disturbing the leaflets at all. It is noticed that the leaves are more sensitive at a certain stage of their growth than later, and that the maximum degree of irritability is reached at a certain period of the day.

Recovery is gradual, not sudden, the time taken in the process varying with the age of the leaf and the intensity of the light. Elaborate investigations have shown that the motile power is centralised in the swellings at the base of the leaflets and leaf-stalks. The fluids filling the cells of one side of the cushions are suddenly transferred to the opposite side, the equilibrium is disturbed, and the leaflets or leaf-stalks must needs move in the direction of least

resistance. It is very interesting to observe, if one gives close attention to the appearance of the pale spots at the base of the leaflets, that a flush of dull green passes over them at the moment of movement. This is most easily seen by holding the stimulated leaflets back. The same change of colour is observed in the cushions of the leaf-stalks.

It is evident that, whatever the nature of the route along which the force of stimulus is conveyed, there must be few obstacles. If it is the case that cell is connected with cell by delicate threads of protoplasm which pass through the cell-walls, means of uninterrupted passage is afforded when the signal to contract or relax is shot along the tissues of the cushion.

It is not generally known that the cotyledons of *Mimosa pudica* also respond to touch. They originally form almost the whole bulk of the seed, and, in germination, rise as fleshy, oval, green leaves. In a warm temperature they move upward fairly quickly, through a considerable angle, when touched. It is of more than passing interest to find sensitiveness exhibited by embryonic structures, especially when they differ so greatly from the adult ones in form.



Seedlings of *Mimosa pudica*.
FIG. 1.—Undisturbed.
c, cotyledon.
FIG. 2.—Touched (nat. size).

While the leaflets of the Sensitive Plant rise to meet each other when irritated, in *Oxalis* (*Biophytum*) *sensitiva* (a plant occasionally grown in greenhouses) they fall. The leaves of this species are pinnate, not trifoliate, as in our native one, wood sorrel.

The purpose served by the movements described is to secure the protection of the foliage. In *Dionaea* and *Aldrovanda*, two of the series of "Insectivorous Plants" studied so minutely by Darwin, the closure of the leaf-blades is to effect the capture respectively of insects and aquatic animals. It may be mentioned as a practical matter that *Aldrovanda* is not easily kept healthy for long, unless in water free from lime.

To many, familiar with the irritability of the Sensitive Plant, the discovery of visible movement in other organs than leaves may not excite much astonishment. If we cautiously examine the flower of any kind of barberry, the columnar pistil will be seen in the centre, with six stamens around it leaning backward, close to the petals and sepals. If the point of a pencil, or the like, be inserted, as if to reach the nectar glands near the base of the petals, there is every likelihood of at least two of the stamens suddenly falling forward against it. After a short interval the stamens gradually fall back and resume their former position, and become ready to repeat the movement when touched. A very few experiments show that the stamen differs from

the leaflet of the Sensitive Plant, in so far that it does not respond unless it is touched in a certain place. It is an interesting test to bring the point of a needle gradually downward, until it reaches the spot in the filament where sensitiveness is located. The petals can be taken away separately, each with a stamen attached, without causing movement. If a stamen, still attached to the petal, is touched at the sensitive point, it curves inwards suddenly, and after recovery will bend again when stimulated. If separated carefully from the petal, laid on a flat surface, and touched, the seat of movement is very clearly demonstrated, the curvature being then seen to take place entirely at the lower part of the filament. The bending is observed to be greater in some species than in others. There is no response to stimuli when the organs are in course of regaining their equilibrium.

The copious supplies of nectar poured out from the glands which lie at the base of the petals attract bees in numbers to the flowers. The instant the proboscis of the bee is inserted, the stamens touched spring forward and cover the insect's head with pollen. In a second he is off to plunder another flower, bearing the fertilising powder with him. A clump of barberry is redolent of honey.

While the stamens in the barberry fall forward, there are some flowers in which they fall backward, when touched. The most easily procured plant showing this is the rock rose (*Helianthemum vulgare*), a low-growing, somewhat woody plant, common on grassy banks and moorland spots. The centre of the yellow flowers is occupied by a tuft of delicate stamens. They stand close together in the undisturbed flower, but when touched at any point they spread out, and the pistil, previously hidden, is then exposed.

Quite a similar mechanism is seen in *Sparmannia africana*, a Cape plant, having no immediate botanical relationship with our rock rose. Occasionally seen in our greenhouses, *Sparmannia* is a shrub of considerable size, with large hairy leaves and trusses of white flowers standing well above the foliage. The individual flowers rise from a pendent to an erect position when about to open. The petals, four in number, are pure white, with a pink spot and " guiding lines " at their base. They, and the four narrow sepals alternating with them, surround the bunch of brightly coloured stamens. The filaments, or stalks, of the outer stamens are bright yellow, and beaded with curious undulate swellings throughout their whole length. The outermost bear no anthers, and terminate in a distinct purple point. The inner stamens, on the other hand, have crimson filaments, with little or no beading, and they carry large pollen-bearing anthers. Transition-forms between the two kinds occur plentifully, the most interesting being such as bear the rudiments of anthers. In the centre is the small superior, spherical ovary, surmounted by the delicate style which is equal in length to the longest stamens. The flowers have a faint odour, suggestive of whin blossom.

When the day is sunny the flowers open well out, so that the

petals are bent back, and the stamens radiate in all directions. The latter are, however, never so far separated naturally but that the slightest irritation will cause them to spread out farther. If a pencil point be applied at the base of a petal, instant divergence of the

Sparmannia africana.
FIG. 3.—Undisturbed. *p*, petal; *sp*, sepal. FIG. 4.—Irritated (nat. size).
FIG. 5.—A stamen (enlarged).

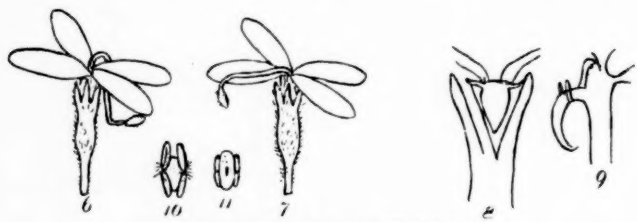
stamens ensues, and the petals and sepals bend still farther back. If the stimulus be severe, the expansion of the tissues uniting the bases of the stamens, and the recurving of the petals and sepals, are so great as to give the flower the appearance of being turned outside in.

The organs return very slowly to the position assumed before stimulation. The swellings on the filaments probably serve the purpose of entangling the head of the insect-visitor, and thus securing more decided irritation. The stigma is well exposed when the maximum spread of the stamens is reached.

The movements exhibited by the androecium of certain composites, notably the corn-flower, have received careful study. If the anthers of a newly-opened floret be touched they are immediately drawn downwards, with a steady motion, by the contraction of the filaments. The pollen, being pressed against the enclosed pistil, wells out for a little at the top of the anther-tube in a steady stream. The stigma is ultimately carried beyond the tube by the elongation of the style.

In the Stylidiaceae, a family very closely related to the Compositae, we find a remarkable modification of the floral mechanism described above. The stamens in *Stylidium* (*Candollea*) are only two in number, and are united with the style to form a trigger-like apparatus, the gynostemium, which hangs outside the flower, and is fixed slightly to a triangular plate—a modified petal—coated with a sticky exudation. Being protandrous, the two anthers occupy at first the summit of this bent column, and in a day or two they wither, and the stigma enlarges

and takes their place. If the action of an insect attempting to enter the flower be imitated, and the lightest touch given in the throat, the protruding organ swings with startling rapidity through an angle of 270°, and comes to lie over the flower with its apex pointing downwards. After a short interval the gynostemium slowly rises and resumes its former position, there to gather energy for another stroke. It is easy to demonstrate that it is most sensitive where it is bent at the throat of the flower. The sudden movement is ostensibly associated with the visits of insects. From the visitor's point of view the reception can hardly be characterised as anything else than violent. One almost feels inclined to think that *Stylidium* has become more annoyed



Flowers and floral parts of *Stylidium*.
FIG. 6.—Flower undisturbed. FIG. 7.—Touched. FIGS. 8, 9.—Sticky shield.
FIGS. 10, 11.—Earlier and later conditions of the apex of the gynostemium. (All enlarged.)

than the barberry at the slow pace of the insects, and has acquired means of suddenly stimulating *them* to greater activity.

It may be mentioned that the nettle, and its allies pellitory and the "Artillery Plant" (*Pilea*) spontaneously and violently fling the pollen out of the anthers, once for all, by the sudden release of the tense filaments at maturity.

A movement analogous to that of the leaves of the Sensitive Plant is seen in the closing of the stigmatic lobes of Musk, *Torenia*, *Bignonia*, Butterwort, and certain other plants, when they are touched.

All motility in flowers, whether spontaneous or induced, has reference to fertilisation processes.

We have confined our attention to examples of plants which perform induced movements quick enough to be seen by the unaided eye. We are greatly tempted to regard the phenomena as sentient, and unwittingly fall into the habit of speaking of them as such. An effort is made, by using the rather ambiguous words "irritable," "contractile," and the like, to avoid giving wrong impressions.

ST. ANDREWS.

The Great Glacial Moraine of Permian Age in South Africa.

By Professor T. Rupert Jones, F.R.S.

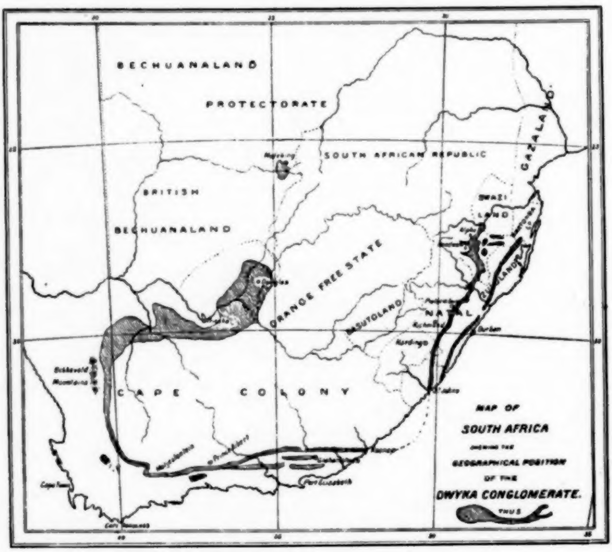
It has often been pointed out that the mountains ranging along and within the coast of the Cape Colony and Zululand, not only have a general parallelism with that coast-line, but consist of parallel groups of stratified formations of schist, sandstone, and conglomerate, with some interruption of granite near the Cape itself, and with a vacant space between Albany and Natal. The upstanding edges of these bedded rocks westward from near the Cape pass in a curved line northward to Namaqualand. On the other side of the Cape they continue into the Eastern Province until they are cut off by the Indian Ocean, south of East London. Nevertheless, as they occur again in the mainland south of, through, and beyond Natal, there has evidently been a loss of the great eastern curve of the parallel ranges, the extreme south-eastern angle of the bluntly triangular southern end of the African continent having been removed by denudation and erosion.

One of the most important of these concentric stratified rocks is the innermost band, known as the "Dwyka Conglomerate," probably of Permian age. It ranges at about a hundred miles or more from the sea in the country north of Cape Town; and after bending eastward at the Cape its distance from the coast is for the most part less than a hundred miles, until it is cut off by the sea at Albany. When it reasserts itself in Natal and Zululand it keeps parallel with, and at no great distance from, the coast; and, as in Albany and elsewhere, is here represented by more than one band.

Mr. A. G. Bain traced this peculiar rock-band from Albany to the Cape (east to west, 450 miles), then on the curve to Toverberg, near the junction of the Doorn and Patatics rivers (50 miles), thence north to Hantam (350 miles). He also noticed two separate narrow masses of this conglomerate to the south of its range, near the Cape, and some parallel duplications, also on the south, in Albany. Thus Bain knew it for about 800 miles in 1856. Since then its northern range on the west side above Hantam and eastward to Douglas (about 50

miles), and northward to Mafeking (about 40 miles), as well as its northward range on the east side, have been mapped by other geologists. From the mouths of the Gualana and Breka rivers to St. John's (40 miles) is a blank, this special band there lying on the ocean-bed. From St. John's to Swaziland is about 70 miles. Altogether, the known length of the outcrop of this "Dwyka Conglomerate" is more than 1000 miles.

Stretching from one side of this southern part of the continent to the other, with a roughly semicircular contour on its southern line, it encloses a large gulf-like area, less oblong and more crescentic than the Bay of Tripoli on the north African coast, and of somewhat greater



Outline Map of South Africa, slightly modified from that published by David Draper in *Trans. Geol. Soc. S. Africa*, 1896, vol. i.

length. Its further extension at the sides to N.W. and N.E., from about lat. 30° S., between the meridians 25° and 33° E. long., probably fails to indicate its real extent.

The locality where this great boulder-band was first specially noticed was at Ecca Vale and Ecca Heights, near Grahamstown; and it has been referred to as the Ecca Conglomerate by some writers, but since E. J. Dunn, formerly Colonial Geologist, noticed a good section of this rock, where traversed by the Dwyka river (one of the head-waters of the Gauritz in Cape Colony), it has been called the "Dwyka Conglomerate."

The constitution of this innermost band of the concentric coast-ranges has been variously described by observers according to its

appearance as seen at different places. It has been described (1) as a rock of igneous origin ("claystone-porphyry"); (2) as being a glacier-formed boulder-clay or moraine; (3) as a breccia composed of angular fragments of volcanic rocks ("trap-breccia"); (4) as having been a long line of beach, consisting of blocks, boulders, pebbles, and sand, with volcanic dust and ashes, on the margin of a wide shallow inland sea or lake, disturbed by subaqueous volcanic eruptions; (5) and lately Dr. G. A. F. Molengraaf, State Geologist, examining this peculiar formation in Zululand, finds evidence that it is really to be regarded as the modified boulder-clay and the moraine of an enormous sheet of land-ice, possibly part of the Antarctic ice-cap of former times; also that, as with other moraines, during the slow retreat of its ice-field, the water draining from it carried away and spread out the pebbles, sand, and mud separated from its coarser materials. These formed special deposits in river-reaches, lakes, and marshes, over a wide area northward of the hollow curve of its line of retreat. This outspread of the morainic material is recognised as the "Ecca Beds," lying parallel with the moraine (Dwyka Conglomerate), all across the Cape Colony and up through Natal and Zululand. Mr. G. W. Stow's "Olive Shales," associated with the "Boulder-drift" of Backhouse and Douglas, north-west of the Hopetown district, come into the same category.

In geological position the Dwyka Conglomerate lies directly upon the Carboniferous quartzite of the Wittebergen and the Zuurbergen, and beneath the Ecca beds, which indeed are interlaced with it at some parts of its range, and pass up into the Karoo beds of Mesozoic age. Hence the glacial conditions, originating the conglomerate or moraine, must have been either in the latest Palaeozoic (Permian) or the earliest Mesozoic times.

How far those ancient glaciers reached northward beyond the present curved morainic border—that is, to what extent glaciers may have occupied the broad hollow, delimited by Palaeozoic rocks, and in which now lie the Ecca and superincumbent Karoo beds, with their concomitant igneous rocks, constituting so large a portion of South Africa—is a subject full of interest.

The long curvature of this ancient moraine may be likened to some of the sinuosities of the irregular line of great moraines crossing North America, and due to the glaciers of the Arctic ice-fields during the relatively modern Glacial Period, often alluded to by geologists as the "Great Ice Age" of Quaternary times.

The mountainous land at the Cape can be only a mere remnant of the high lands once reaching southward to the Arctic Circle, and far beyond it, if continuous with the existing visible polar lands, which are about 30 degrees south of the Cape. (See G. W. Stow's remarks on this continent, *Quart. Journ. Geol. Soc.*, 1871, vol. xxvii. p. 546, etc.)

Whether a perfect polar ice-cap or partial ice-fields originated the

morainic fringe of which the Dwyka Conglomerate remains in evidence, Palaeozoic and Archaean rocks must have pre-existed, and have been covered up and worn down by the glacial covering. And of its scrapings, scorings, and smoothings, evidence doubtless still exists among their hills, valleys, and gorges, their krantzes, kloofs, and poorts in that maritime region, including Namaqualand, Clanwilliam, Malmesbury, Swellendam, George, Kuysa, and their neighbouring divisions, except where obliterated by subsequent weathering.

Some of their morainic materials may have been left as *terminal* like the Dwyka band, or as *local* belts during retreat, like those seen in the Zwarte Rug of the Cold Bokkeveldt, and in the Witteberg, in Cape Colony, and in the Zuurberg in Albany, and near the coast in Zululand.

Some of the memoirs more particularly treating of the Dwyka Conglomerate :—

A. G. Bain, *Trans. Geol. Soc.*, 1845, ser. ii. vol. vii. part ii. p. 54 ; and 1856, part iv. p. 185.
A. Wyley, "Notes on a Journey in Two Directions across the Colony," 1859.
P. C. Sutherland, *Quart. Journ. Geol. Soc.*, 1870, vol. xxvi. p. 514.
C. L. Griesbach, *Quart. Journ. Geol. Soc.*, 1871, vol. xxvii. p. 58.
G. W. Stow, "The Backhouse and Douglas Boulder-drift and Olive Shales," *Quart. Journ. Geol. Soc.*, 1874, vol. xxx. pp. 599, 634, etc.
E. J. Dunn, "Report on the Camdeboo and Neuweldt Coal," 1879.
A. H. Green, *Quart. Journ. Geol. Soc.*, 1888, vol. xliv. pp. 241 *et seq.*
D. Draper, *Quart. Journ. Geol. Soc.*, 1894, vol. l. p. 559.
—— *Trans. Geol. Soc. S. Africa*, 1896, vol. i. pp. 90, etc.
G. A. F. Molengraaf, *Trans. Geol. Soc. S. Africa*, 1898, vol. iv. pp. 103-115.

17 Parson's Green, London, S.W.

The Penycuik Experiments:[1] An Appreciation.

By J. Arthur Thomson, M.A.

Without raising the vexed question of the relative value of reflection and experiment, or admitting that the antithesis is a just one, we may take it that one of the most hopeful signs of progress in evolution-theory is the increasing prominence of experimental work, and it is on this general ground first of all that we welcome Prof. Cossar Ewart's studies in heredity, well known in interested circles as "The Penycuik Experiments." For it is certain that we have here no fireside musings as to what might be, but the work of a persistent and patient experimenter, with his coat off and his sleeves up, trying to discover what is.

In giving some account of what has been done by Prof. Ewart, one meets the difficulty that most of the points tested are necessarily concerned with individual animals, which, however familiar to the experimenter, are very apt to get mixed in the mind of an outsider. In order, then, to avoid the somewhat fatiguing exercise of keeping Matopo and Mulatto, Romulus and Remus, Biddy and Brenda, Norette and Hekla, as clear individualities in the mind—which is easy enough with the beautifully illustrated book before us—we propose to find the thread of our summary rather in the general ideas than in the fascinating living things. And the ideas round which the experiments have arisen are Reversion, Prepotency, Inbreeding, Telegony.

Reversion.

A great part of the work done concerns zebra hybrids, of which nine (zebrules) were got from the Burchell zebra stallion, Matopo, and various mares, and others from zebra mares served by pony (zebrinnies) and donkey. These hybrids, charming and beautiful creatures, may turn out to be of high practical value, but their present interest is mainly theoretical.

It may be pointed out first of all that the numerous previous

[1] "The Penycuik Experiments," by J. C. Ewart, M.D., F.R.S., Regius Professor of Natural History, University of Edinburgh. 8vo. pp. xciii. + 177, with 46 figs. London: A. and C. Black, 1899.

experiments on hybridisation, made by botanists, zoologists, and practical people, have led us to expect one of three results when a crossing has a successful issue. (1) The hybrid may be intermediate between its parents, sometimes so exactly that we may liken the blending to warp and woof; or (2) the hybrid may show an exaggeration of the characters of one parent, often with little apparent realisation of the peculiarities of the other; or (3) the hybrid may be very different from either parent, showing features at first sight novel, but which on closer investigation are sometimes interpretable as the reassertion of the characters of a remoter ancestor. But the extraordinary thing is that at least two of these three different results may be illustrated in one brood or litter.

According to the theory of reversion, confessedly a somewhat unfortunate term, the resemblance which an offspring often exhibits to a more or less distant ancestor, is due to the realisation of characters which were throughout part of the inheritance, but remained latent or unexpressed for one or more generations. As to the fact of resemblance to ancestors there is no more doubt than there is as to resemblance to parents; the theoretical element is simply in the idea of latent characters. If we do not accept the idea that resemblance to ancestors is due to the reassertion of latent elements in the inheritance, we must find some other explanation. And there seem to be two possibilities—(1) that the ancestral resemblance may be due to the fresh and independent occurrence of the same permutations and combinations of germinal material as took place when the ancestral character had its origin; or (2) that the character of resemblance may be an individually acquired "modification," reproduced, apart from inheritance, by a recurrence of suitable external conditions.

It seems impossible to read the literature on the subject without becoming convinced that many phenomena are labelled reversions on the flimsiest of evidence. Thus the occurrence of a Cyclopean human monster with a median eye has been called a reversion to the sea-squirt, and gout has been called a reversion to the reptilian condition of liver and kidneys. Often there has not been the slightest attempt made to discriminate between true reversion (*i.e.* the re-expression of latent ancestral characters) and the phenomena of arrested development, or of abnormalities which have plainly been induced from without. Often, too, there has been no scruple in naming or inventing the ancestor to whom the reversion is supposed to occur, although evidence of the pedigree is awanting; and the vicious circle is not unknown of arguing to the supposed ancestor from the supposed reversion, and then justifying the term reversion from its resemblance to the supposed ancestor. Little allowance has been made for coincidence, and the postulate of characters remaining latent for millions of years is made as glibly as if it were just as simple as a throw-back to a great-grandfather.

Now it is one of the merits of Professor Ewart's work that he has done much to place the doctrine of reversion on a firmer basis of carefully criticised instances. While Mr. Bateson expressed the views of many when he said—"Around the term reversion a singular set of false ideas have gathered themselves," and that "it would probably help the science of biology if the word 'reversion' and the ideas which it denotes were wholly dropped, at all events until variation has been studied much more fully than it has yet been," Professor Ewart's cases will certainly tend to reassure the doubtful as to the reasonableness of the reversion interpretation.

Just as von Baer made the chick pre-eminently the bird of the embryologist, so Darwin made the pigeon pre-eminently the bird of the biologist, and Professor Ewart gives it the first place in his systematised record of experiments. The most striking case is the following:—A pure white fantail cock, which in colour proved to be prepotent over a blue pouter, was mated with a cross previously made between an owl and an archangel, which was far more of an owl than an archangel. The result was a couple of fantail-owl-archangel crosses, one resembling the Shetland rock-pigeon, and the other the blue rock of India. Not only in colour, but in form, attitude, and movements there was an almost complete reversion to the form which is believed to be ancestral to all the domestic pigeons. The only marked difference is a slight arching of the tail. The one parent, a white fantail, belongs to an old-established breed; the other parent, an owl-archangel cross, had already more or less lost the characters of the relatively recent archangel, and had begun to revert towards the blue rock; the progeny of the two was a practically complete reversion. The interpretation suggested is that the older and more stable ancestral units assert themselves successfully in the germinal struggle, while the newer features attain no development.

A few other examples may be noted. An Indian game Dorking cock, crossed with a dark bantam hen, produced amongst others a cockerel almost identical with a jungle fowl (*Gallus bankiva*), *i.e.* with the original wild stock.

A smooth-coated white rabbit, derived from an Angora and a smooth-coated white buck, was mated with a smooth-coated, almost white doe (granddaughter of a Himalaya doe), with very interesting results, significant of the complexity of the conditions. In the litter of three, one is the image of the mother, one is an Angora like the paternal grandmother, and one is a Himalaya like the maternal great-grandmother.

Again, the Burchell zebra-horse hybrids are in their markings very unlike their zebra sire or dam, but bear distinct resemblance in their stripes to the Somaliland zebra (*Equus grevyi*), which the author regards as, in its markings at least, the most primitive of all living zebras. But the evidence from pigeons and rabbits seems stronger than this.

It must be carefully noted that the experiments have been numerous, for it is only thus that the element of coincidence can be duly allowed for. And the general result stands out clearly that the reversion-interpretation has received substantial support.

At the same time it seems extremely doubtful whether such a phenomenon as a complete ulna in a horse, and other cases of the same sort which are cited, furnish any relevant evidence of reversion.

Prepotency.

When an organism of either sex shows great power in transmitting its individual characteristics, it is said to be prepotent as regards these. A stallion or a mare, a bull or a cow, may be so prepotent that its characters reappear in a high percentage of the offspring, no matter what the other parent may be.

It seems doubtful whether anything beyond convenience is gained by the word prepotency—since all these general terms are apt to form the dust-particles of intellectual fog; what we have to do with is the fact that certain variations are markedly stable, heritable, and persistent, almost aggressively persistent one might say. It seems likely that they express positions of relatively great organic equilibrium.

The quality of prepotency is obviously a relative one, and only verifiable in its results. That is to say, it is never more than probable in its exercise. Nor are we able, at the present stage of biological analysis, to define with any precision wherein the secret of prepotency actually lies. We have hardly got beyond imagining that there is a struggle in the germ-cells before and after fertilisation, and that there is a survival of the fitter components within the microcosm of the ovum just as in the macrocosm outside.

Yet, in spite of the obscurity which shrouds the interpretation, the fact of prepotency is certain, and it is of direct human interest not only in connection with the breeding of stock, but also as regards the evolution of races of men. The stud-books show the enormous value of a prepotent sire, and we may regard the persistence of a Celtic, Semitic, or Gipsy strain, in spite of complex intercrossing in the pedigree, as an illustration of prepotency.

This quality, so potent for good or ill, may arise in one of two ways—(*a*) as an attribute of a "sport" or discontinuous variant, or (*b*) as the result of inbreeding. As to the former, Standfuss, who has had so much experience in hybridising butterflies, says that when a sporadic variety is crossed with the normal form of the stock the result is that the offspring agree either with the normal form or with the sport, intermediate forms being absent. ["Handbuch der palaearktischen Gross-Schmetterlinge," 2nd edition. Jena, 1896]. Similarly, Mr. J. W. Tutt reports among the conclusions of Dr. Riding and Mr. Bacot as to hybridising species of *Tephrosia*, that while the (phylo-

genetically) older species is usually dominant, a recently-formed aberration may be prepotent over the type from which it has but recently arisen [*Trans. Entom. Soc. London*, 1898, pp. 17-42]. Mr. Galton holds a similar view, and regards prepotency as itself "a heritable sport or aberrant variation."

While in no way overlooking or combating this position, Prof. Ewart lays emphasis on the second, and probably more frequent origin of prepotency, as the result of inbreeding. "Some breeders say that they can produce a horse so prepotent, so fixed by interbreeding, that it will produce its like however mated"; and there is much evidence to show that, of two parents, the more inbred—up to a certain limit of stability—is likely to have the greater influence on the offspring.

A few examples will suffice. An inbred Dalmatian dog is likely to be prepotent over a collie, a Basset hound over the ancestral bloodhound, an inbred hornless Galloway over one of the long-horned Highland cattle, and Semitic over English blood.

As inbreeding is frequent in nature, especially among gregarious and isolated groups, and as it tends to develop prepotency, we are able to understand better how new variations may have persisted in the course of evolution. The old difficulty that new variations would tend to be swamped or levelled down by intercrossing was met by Romanes and Gulick in their theory of Isolation, some form of which was supposed to limit the range of effective intercrossing. But as this theory has not been sufficiently demonstrated, Prof. Ewart justly insists on the importance of prepotency as an evolutionary factor. But may it not be said that the prepotency which results from inbreeding is itself the result of some form of Isolation? Even preferential mating is a form of Isolation in the wide sense.

Just as in connection with the determination of the sex of the offspring, which may be the resultant of many factors, so in the case of prepotency the result which may be reasonably predicted does not always come off, the natural prepotency being counteracted by other influences due to vigour, age, nutrition, and environment.

The unpredictable nature of the results is well illustrated in Prof. Ewart's observations on crossing wild and tame forms. When white doe-rabbits were paired with wild brown bucks, the progeny resembled the wild form; but of the nine zebra-horse hybrids only two take predominantly after the wild parent. The experiments which others have made on butterflies suggest the conclusion that the older form will tend to be dominant, but this may simply mean that the hybridisation has evoked reversion. We seem to have securer evidence as to prepotency in such a case as the Basset predominant over the bloodhound from which it is derived.

The experiments of Standfuss tended to the conclusion that in hybridising the male parent was prepotent over the female; the young forms were at first liker the female (which may be in part due to the

ovum being relatively much larger than the sperm), but with further growth the resemblance to the male gradually increased. But in the experiments recorded by Mr. Tutt, it is noted that the influence of the male parent seems to be less than that of the female. It seems likely that the discrepancy is to be in part accounted for on the lines of Mr. Vernon's conclusion as to sea-urchins, that the characteristics of the hybrid offspring depend directly on the relative degrees of maturity of the sex-cells of the two parents. Professor Ewart has not found any reason to regard prepotency as correlated with sex. As he cautiously says:—"When allowance is made for reversion, inbreeding, and various other factors, it is extremely difficult to estimate how far the one sex predominates over the other."

Inbreeding.

The diversity of opinion in regard to inbreeding, which some exalt as essential to the success of a race, and others decry because of alleged baneful influences, is probably due to the fact that it is beneficial only up to a given limit, and that it is apt to fail prematurely because of some taint in the stock.

On the one hand, it is advantageous in fixing character or developing prepotency, as Professor Ewart illustrates by Dalmatian dogs, Basset hounds, and hornless Galloway cattle. As Galton maintains, the mating of two extraordinary members of two stocks is likely to be followed by a heavy filial regression, while this tends to be slight between two equally-gifted but not extraordinary members of a high-class inbred stock. Moreover, with the extension of an untainted pedigree the risk of serious reversion is probably lessened, for there are probably limits to the duration of latent characters. In other words, the more thorough the inbreeding, within the limits of stability, the less will be the normal quantitative filial regression, and the less will be the risk of the more qualitative reversion. On the other hand, as to disadvantages, there is on *a priori* grounds a necessary lessening of variability, since that is in part conditioned by cross-breeding; and there is the actual fact that inbreeding often goes too far, and results in loss of vitality and in degeneration. Professor Ewart instances the cases of foxhounds, hogs, guinea-pigs, and race-horses. Sir Everett Millais noted in regard to inbred dogs that distemper carries off about 60 to 70 per cent. of those attacked, and that hereditary deformity and disease tend to be induced.

It may be of interest to recall the experiments which Ritzema Bos made some years ago with rats (*Mus decumanus*). From seven of one family and an unrelated male which died after two crossings, he continued inbreeding for six years, about thirty generations. In 1887 the average number of a litter was $7\frac{1}{2}$, in 1891 $4\frac{7}{12}$, in 1892 $3\frac{1}{5}$. The rate of mortality and the number of infertile pairings greatly increased (*Biol. Centralbl.* 1894, xiv. pp. 75-81).

Believing that the inbreeding of race-horses in Britain has now passed beyond the limit of stability, and that the stock is on the down-grade,—a danger dreaded by many with an anxiety which seems to others uncalled for—Professor Ewart points out that the racer, whose artificial evolution has cost so much, may be saved by bringing in fresh blood in the form of imported Barb and Arab mares (as Sir Everett Millais saved his Bassets by bringing in bloodhounds), or by crossing with imports from America and Australia, which have become somewhat different in their new environment.

All this is of much interest in connection with mankind. Thus it has been maintained, as recently by Reibmayr (*Nat. Sci.* xiv. p. 95), that the evolution of a human race implies alternating periods of dominant inbreeding and dominant cross-breeding. The inbreeding is necessary to give fixity to character, the cross-breeding is necessary to avert degeneracy and to stimulate new variations which form the raw material of future progress. The antithesis between the Jews with their persistent inbreeding, and the complex cross-breeding at present conspicuous in America, is one of almost diagrammatic vividness.

On the vexed question of the sterility of hybrids and what it means when it occurs, Professor Ewart has not as yet been able to shed much light. It is well known that hybrids between different species are sometimes quite fertile, as in the case of the crosses between common goose and Chinese goose, common duck and pintail duck; in other cases, however, the result is sterility. Thus it has not been proved that a female mule has ever produced a foal, though she may produce milk. It is remarkable that the reproductive organs do not seem to have been investigated either in mule or hinny.

In the two-year-old zebra-horse hybrid Romulus, the reproductive organs and instincts seem to be fully developed, but the reproductive elements are still immature (with the merest rudiment of a tail). The same was true of a male zebra-ass hybrid, which unfortunately died. In a female zebra-mule (zebrule), the reproductive organs, which were of a zebroid type, seemed normal, and the ovary showed well-developed follicles; but no proof of fertility has yet been obtained in any case. A nine-year-old zebrinny (horse-zebra hybrid) seemed sterile with both Arab and Clydesdale horses.

Telegony.

The interest which is so often aroused by obscure phenomena is well illustrated in connection with telegony,—or the supposed influence of a sire on offspring not his own, but by the same mother. The literature of the subject suggests that dealing with the somewhat cognate problem of maternal impressions, it tends to be anecdotal rather than precise. The discussion practically dates from Lord Morton's famous letter to the Royal Society (1820), in which he related

that an Arab mare which had borne a hybrid to a quagga, had subsequently colts by a horse, and that these were marked by stripes and by some other peculiarities supposed to be quagga-like. Agassiz, Darwin, Spencer, and others have expressed their belief in the fact; Settegast, Nathusius, Weismann, and others are extremely sceptical; Professor Ewart has followed the path which Romanes had only time to set foot upon, the only secure path, that of definite experiment.

In general terms, he has made a number of experiments likely to give telegony the best possible chance of declaring itself, and although he displays his scientific mood in abstaining from dogmatic conclusion, and in suggesting fifteen other experiments which should be made, the verdict is that so far the evidence of any undoubted telegony is most unsatisfactory. The experiments prove this at least, that telegony does not always occur, indeed that anything suggestive of it occurs only in a very small percentage of cases. Moreover, where peculiar phenomena of inheritance were observed, they seemed to be readily explicable by the reversion hypothesis. It is impossible to withhold admiration when we consider these experiments, involving as they have done so much patience and vigilance, hindered as they have often been by mortality, and very costly withal. If Professor Ewart had originally any bias on the matter, there is no trace of this in his experimentation and exposition.

The most general form of the belief in telegony may be called the infection hypothesis, the idea of which is that the reproductive organs of the mother are specifically infected by having offspring to a particular male,—so specifically infected that her subsequent offspring by other males may exhibit some characteristics of the first sire. The race-horse Blair Athol had a very characteristic blaze, or white bald face; it is said that mares after having foals to Blair Athol, produced Blair Athol-like foals to other stallions utterly unlike Blair Athol. It is supposed that this resemblance was due to an infection of the germinal material by the Blair Athol semen.

A slightly modified form of the infection hypothesis is that of saturation, according to which it is supposed that the characters of the sire expressing themselves in the unborn embryo saturate into the dam, and affect her constitution in such a way that her offspring by subsequent sires inherit some of the characteristics of the first. But while it is conceivable that this may sometimes be the case with a poison or a protective toxin which might diffuse in and out, it seems almost inconceivable when we think of structural characters. We can imagine that a sire infected with some virulent disease, and showing certain structural disturbances associated therewith, may have offspring which are similarly affected, and that the influence from them unborn may saturate into the mother and affect her, so that subsequent offspring by a healthy sire are modified after the manner of the first.

But such cases have a practical rather than a theoretical interest; they hardly touch the problems of heredity or evolution.

On *a priori* grounds, the probabilities are strongly against the occurrence of telegony, but there is no foothold except in the experimental test, and that is what Professor Ewart has given us.

The general nature of the experiments is well known, and for the interesting details the book and its beautiful pictures must be consulted. It may suffice to mention one of the best cases. A Rum

Fig. 1—Matopo.

Fig. 2—Romulus.

pony mare, Mulatto, was served by the Burchell zebra stallion Matopo, and the result was Romulus, with markings quite different from those of his sire, but suggestive rather of the Somali type. In 1897 Mulatto had a bay colt foal to a gray Arab stallion, and this foal—unfortunately short-lived—gave no proof of telegony. The stripes which most frequently occur in horses were absent; there were others which are not uncommon in horses; but the most distinct markings (not that any were strongly developed), namely, those across the croup, were of a sort extremely rare in both foals and horses. In short, the marking of Mulatto's second foal is puzzling, but in no definite

way suggestive of telegony. In this, as in other cases, the verdict must be non-proven.

The psychological problem is interesting, how the belief in telegony has become so very widespread; and the probable answer is twofold, that people are indescribably careless about their beliefs, breeders being notoriously too superstitious, and that the more careful may be easily misled by reversion phenomena which have resulted from the intercrossing. When instances of apparent telegony, of which there are many on record, are carefully analysed, or when the pedigree is traced back, flaws and fallacies are in most cases revealed, as Dr. O.

FIG. 3—Mulatto's Second Foal.

vom Rath has well shown in an intricate family history of cats (*Biol. Centralbl.* 1895, xv. pp. 333, 334).

To sum up: These interesting experiments, of which it is to be hoped we have had only a preliminary instalment, afford vivid illustrations of the unexpectedness of consequences in hybridisation, some cogent scientific evidence of reversion, some analysis of prepotency and its connection with inbreeding, and some demonstration of the difficulty of proving telegony. In more general terms, they have already done not a little towards the fulfilment of Professor Ewart's main intention of making breeding less empirical and the facts of inheritance less obscure; and all biologists will agree in looking with eagerness for more "Penycuik Experiments."

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The Geographical Distribution of the Arachnida of the Orders Pedipalpi and Solifugae.

By R. I. Pocock.

Since the science of zoo-geography has hitherto been studied mainly from the vertebrate standpoint, one of the most interesting developments of the science in the future will be to discover whether the results obtained by a knowledge of the distribution of the orders of terrestrial invertebrates contradict or coincide with those that have been obtained by a study of the reptiles, birds, and mammals. Moreover, since it is generally admitted that the only means of mapping the various geographical realms, regions, and provinces, on the basis of an acquaintance with the dispersal of all land-species, is the publication on the part of specialists of charts representing the range of the orders, families, and genera with which they alone are familiar, it behoves all systematic workers who are interested in this important branch of zoology to contribute what they can to this desirable result.

In the May number of *Natural Science* for 1894 I briefly discussed the geographical distribution of scorpions, and attempted to map out the regions which the ascertained facts with regard to the range of the families and genera of these Arachnida seemed to establish. In the present paper I propose to deal in the same way with two other orders of the class, namely, the Pedipalpi and Solifugae. Unfortunately, to many of the readers of *Natural Science* these names will perhaps convey no idea of the nature of the animals under discussion; but since it is impossible to enter at length into an explanation of their systematic position, a very few words on this point must suffice.

The term Pedipalpi is applied to a group of Arachnida which, while possessing striking structural peculiarities of its own, lies in many respects midway between scorpions and spiders. It is divisible into two sub-groups; the Uropygi or tail-bearing Pedipalps, in which the last abdominal somite retains, in the form either of a many-jointed feeler or of a one-jointed horny piece, a post-anal sclerite or telson, the homologue of a scorpion's sting; and the Amblypygi or tailless Pedipalps, in which this sclerite has disappeared. These two sub-groups, the Uropygi and Amblypygi, are so very distinct that in the following

pages I have treated them entirely apart. The best known members of the Uropygi are sometimes called whip-scorpions, in allusion to their superficial resemblance to the true scorpions, and to the thread-like form of the long many-jointed tail-piece. They were formerly comprehensively spoken of in works on zoology as *Thelyphonus*. Similarly the Uropygi, which, owing to the shortness and greater width of the body and to the absence of a "tail," are more like spiders than scorpions, are better known collectively as "*Phrynus*."[1]

The Solifugae (or Solpugas) constitute a fourth "group" of Arachnida, very distinct indeed from the scorpions, Pedipalpi, and spiders, though often by the uninitiated confounded with the latter on account of their similarity in external form. The most familiar names connected with this order are *Galeodes* and *Solpuga*.

In many respects these Arachnida and the scorpions are well suited for the study of zoo-geographical problems. In the first place, as compared with other terrestrial invertebrates, they are for the most part of considerable size, and are on that account not likely to have been overlooked by collectors in any of the land-areas, like New Zealand, where they appear to be absent. In the second place, the mutual relationships of the genera[2] are tolerably well understood. In the third place they are practically dependent for their dispersal upon continuity of land, since they cannot fly, and there is no reason to suppose that they are able to swim or even to float; nor is it likely that they can withstand immersion for any length of time in either fresh or salt water, and except in the case of one or two species of scorpions, there is no evidence, nor indeed any reason to think, that their distribution is due to human agency. In the fourth place, since they are exclusively carnivorous, and will eat anything in the way of animal life from small vertebrates to insects, centipedes, and worms, none of the species are limited by the nature of their diet to any one particular locality, their food being universally distributed.

Lastly, although they reach the maximum of their development both as regards size of individuals and numbers of species and genera in the tropical and warmer temperate parts of the world, it would be erroneous to suppose that they are only capable of supporting life in countries where the temperature is warm and fairly uniform throughout the year. Scorpions, for example, are found at high altitudes in the Alps (7000 ft.), and as far to the south in Patagonia as the 50th parallel of latitude, where the mean temperature of winter is a little above freezing-point. Species of *Galeodes* (Solifugae) occur in the steppes of South Russia and Western Asia where the scorching heat of summer is succeeded by a winter of corresponding rigour. Even the whip-scorpions (Thelyphonidae) extend in Eastern Asia up to about

[1] In systematic zoology this name has dropped out of use as a synonym of the older name *Tarantula*.

[2] Except possibly in the case of some genera of Solifugae.

45° N., where, according to Mr. Buchan's charts, the mean temperature of July is the same as that of South Europe, but that of January is lower than that of the north of Scotland. So, too, in the case of the tailless Pedipalpi, although they only pass a short distance to the north of the Tropic of Cancer, yet they have been met with in Patagonia as far to the south as latitude 50°, where the mean annual temperature is only about 40° Fahrenheit, being about 55° in midsummer (January) and 34° in winter (July).

Moreover, the structural differences that obtain between the species capable of withstanding for some months of every year the lowness of temperature expressed or implied in the above statements, and the species that inhabit tropical or, at all events, very much warmer climes, are often only of specific importance. For example, the Manchurian Pedipalp (belonging to the Thelyphonidae) is closely related to one that occurs at Hong Kong, to the south of the northern tropic; the Patagonian tailless Pedipalp is congeneric with a form that is found in equatorial East Africa; the *Galeodes* of the Russian steppes is a near ally of a species that flourishes in the perennial heat of the deserts of South Arabia and Somaliland; and the Alpine scorpion is similarly related to forms that exist in South Italy and Algeria.

So, too, with regard to moisture. Although, broadly speaking, it is true that desert forms are not met with in forest-covered areas, nevertheless genera of Solifugae, which abound in the arid plains of Arabia and North Africa, have representative species in parts of West Africa and India, where vegetation is luxuriant. Congeneric species of Amblypygous Pedipalpi occur in deforested tracts of South Arabia, and in Malabar and Ceylon, where the physical conditions are very different, and a species that has been found in caves in the Philippine Islands has been collected by Mr. Oates beneath stones on the seashore in the Andamans. Nearly allied species of *Butheolus* (scorpions) are met with in Sind, with an annual rainfall of about four inches, and at a place in Satara in the Dekhan, where the average fall is about thirty inches. And lastly, Professor Wood Mason's statement that species of whip-scorpions were only discovered in Assam during the heaviest rains and soon died when removed from their humid surroundings, should be compared with that of M. Schwarz to the effect that the Floridan species frequents dry and sandy spots.

From these data it is evident that the Arachnida in question have very considerable powers of adaptation to varied physical conditions. Consequently their absence from certain areas of the earth's surface must not be too hastily explained away on the plea of unsuitability of environment.

Unfortunately our knowledge of the fossil forms of these animals is extremely scanty. Of the past history of the Solpugas we know absolutely nothing. Pedipalpi, referable both to the Uropygi and Amblypygi, have, however, been discovered in Carboniferous strata.

The Uropygi were represented by the genus *Geralinura*, which apparently differed but little from the existing Thelyphonidae, and has been found both in Europe (Bohemia) and in North America (Illinois). The fossil forms, which seem to me to be referable to the Amblypygi, have been named *Graeophonus* and *Geraphrynus*,[1] the former being based upon remains from the Carboniferous beds of Cape Breton in Nova Scotia, the latter from those of Illinois. But from Palaeozoic times down to our own day the past history of the Pedipalpi is an absolute blank.[2] Nor is our knowledge of fossil scorpions much more complete. Although several genera and species have been described from Upper Silurian and Carboniferous beds, both in North America and Europe, only one species has been recorded as existing during the immense period of time that has elapsed since the Palaeozoic epoch. This was obtained in the oligocene amber beds of the Baltic.

Nevertheless, scanty as are these data, they afford support to the view that these Arachnida originated in, and were widely distributed throughout, the northern hemisphere.

In attempting to establish geographical areas based upon a study of these Arachnids, one important consideration must be borne in mind, namely, that we are dealing with organisms which are wonderfully specialised in particular directions and highly conservative in structural characters. The scorpions, in fact, furnish a famous example of a persistent type of life, and in this particular they do not surpass the Pedipalpi of the family Thelyphonidae. Considering the wonderful changes that have affected the northern hemisphere since Palaeozoic times, it is astonishing that these Arachnids have varied so little. To many zoologists the characters upon which the orders are divided into families, genera, and species may seem of small importance as compared with those of such highly plastic animals as the Mammalia; but keeping in view the fixity of their characters as a whole, it seems clear that what is regarded as a specific or generic difference between two forms may represent a period of separation sufficiently long or a change of environment sufficiently great to produce differences of far higher systematic value in more plastic organisms. Consequently a generic

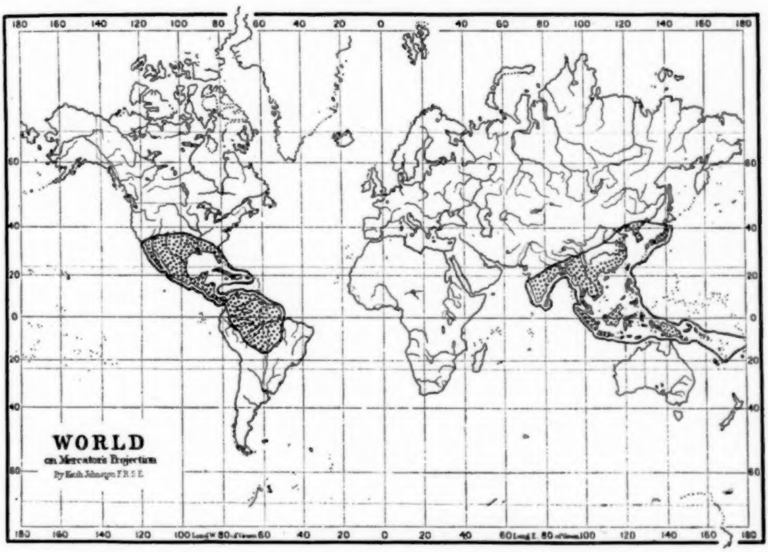
[1] Described by Mr. Scudder. This is no place to attempt a detailed criticism of this author's work on fossil Arachnida. The expenditure of a little trouble in gaining an acquaintance with the morphology and classification of recent forms would have given his monograph a value to which at present it can lay no claim. Without an examination of the fossils, one's criticisms are, more or less, guess-work, but, judging from the figures, it appears to me that Mr. Scudder has, in more than one instance, mistaken the ventral for the dorsal aspect of his specimens, has referred to the same species specimens presenting characters probably of generic importance, and has placed in the same order, Anthracomarti, representatives of the existing orders of Araneae, Opiliones, and Pedipalpi. The genus *Graeophonus*, which is almost certainly an Amblypygous Pedipalp, he places in the family Geralinuridae, alongside of *Geralinura*, an unmistakable Uropygous form.

[2] The so-called Tertiary *Phrynus* from the Oligocene beds of Aix, cited in works on Palaeontology, and described ten years ago by Gourret as *Phrynus marioni*, is not a *Phrynus* (Pedipalp), as a glance at the figure will show, but a spider allied to the Carboniferous *Arthrolycosa* and the existing *Liphistius*.

difference between the species of two areas may, if desirable, be regarded as of sufficient value to warrant their separation as geographical regions. Similarly the occurrence of the same specific form in two adjacent islands, for example, does not necessarily imply that the separation of the two islands is of recent date.

Distribution of the Uropygi.

The tailed Pedipalps or Uropygi are divided into two sub-orders, the Oxopoei and the Tartarides. The latter is a group that is but little



Map illustrating the geographical distribution of the Uropygous Pedipalps.

known and comprises some very small degenerate forms that have been met with only in Burma, Ceylon, and Venezuela. No doubt they will be discovered elsewhere in the Tropics when adequate search has been made. There is, indeed, a dubious record of a species from Liberia in West Africa; but until the group has been further investigated, it cannot be considered a very important factor in the study of zoo-geography. Two genera are recognised: *Tripeltis,* with a slender cylindrical telson, discovered in Ceylon and Burma, and *Schizonotus,* with an expanded, somewhat spatulate telson, in Ceylon and Venezuela.[1]

The existing forms of Oxopoei are referred to a single family, the Thelyphonidae, divisible into two sub-families, each represented by several genera, which are distributed over the south-eastern

[1] This genus has also been introduced into conservatories in Europe, in connection with exotic plants.

portions of Asia, from Ceylon and China to the Fiji Islands, and in the southern states of North America, Central America, the West Indies, and the tropical parts of South America.

The first sub-family (Thelyphonini) contains the following genera:— *Thelyphonus*, composed of a large number of species, and occurring in Ceylon and South India, Burma, South Siam, and the Philippine Islands; thence over the whole of the Indo-Malayan and the Austro-Malayan Islands to Fiji and the New Hebrides, just touching Cape York, but not extending further into Australia. Very closely allied are the genera *Abalius* and *Tetrabalius*, the former with representative species in New Guinea, New Britain, and Samoa, the latter occurring in Borneo and the Moluccas. *Mimoscorpius*, another allied form, contains a single species recorded from the Philippines. To the north of the area occupied by *Thelyphonus* occur two genera: *Uroproctus*, peculiar to Assam and the eastern parts of Bengal, and *Typopeltis*, which extends from Hong Kong and Formosa into Japan, and a little to the north of the 40th parallel of North latitude in Amurland. In America the sub-family is represented by the single genera *Mastigoproctus*, which has representatives in Arizona, Texas, Florida, Central America, Hayti, Martinique, and in Brazil, as far at all events to the south as Matto Grosso. The second sub-family (Hypoctonini) contains only three genera: *Labochirus* confined to Ceylon and South India; *Hypoctonus* occurring in Silhet, Burma, and Borneo; and *Thelyphonellus*, which has been met with in Guiana and on the Amazons.

This family shows but little structural differentiation. It is consequently difficult to formulate any definite conclusions respecting the geographical regions or sub-regions that may be recognised, on account of the close relationship that obtains between the genera that are found in the eastern and western hemispheres, the differences between them being no greater than those between the species of China and Assam, or Borneo and Java.

For the area in South-Eastern Asia to which these animals are restricted, the term Oriental may be retained, although it is by no means identical with the region of that name defined by Wallace, inasmuch as it embraces part of his Manchurian sub-region of the Palaearctic, as well as the whole of the Austro-Malayan, and part of the Polynesian sub-region of the Australian Region.

The sub-regions of this area are doubtful both in number and extent. The area, however, extending from Corea to Hong-Kong and characterised by the presence of *Typopeltis* and the absence of the more southern types may be recognised as the Manchurian; and if we eliminate as the Assamese the area to which *Uroproctus* is restricted, and as the Ceylonese or Malabar, the part of South India and Ceylon where *Labochirus* is alone found, the rest of the region will correspond very closely to the Malayo-Papuan area so well characterised, as will be explained, by one of the families of Amblypygous Pedipalpi.

In the American continent the area inhabited by this family may be termed the Neotropical. The characteristic genus is *Mastigoproctus*, most nearly allied to the Assamese *Uroproctus*, and extending from the Southern States (California, Texas, and Florida), into the heart of Brazil and including the Greater Antilles. Up to the present time the genus *Thelyphonellus* is only known from the northern parts of South America. On this basis we may perhaps separate the region into two sub-regions, a Northern or Central American, and a Southern or Brazilian.

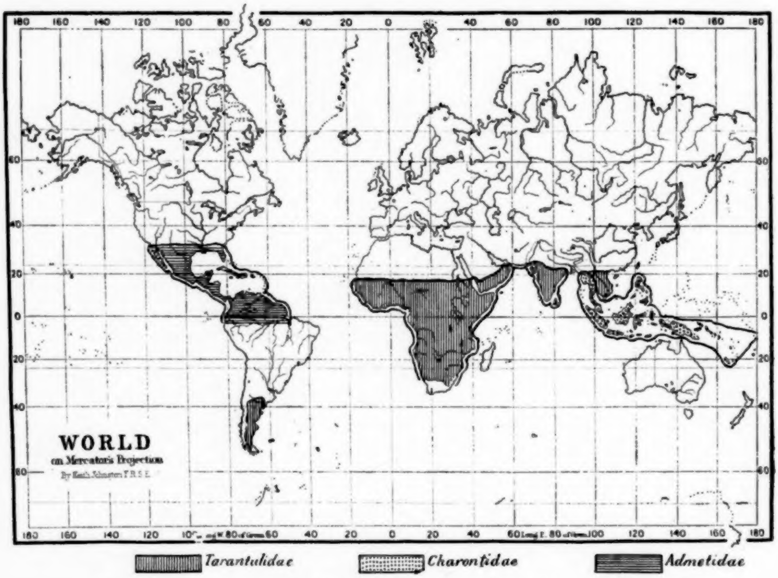
Distribution of the Amblypygi.

By certain structural characters which it is beyond the scope of the present paper to discuss, the Tailless Pedipalpi or Amblypygi may be divided into three families — the Admetidae, Charontidae, and Tarantulidae.

The Admetidae are confined to America, where the family is represented by three genera: *Heterophrynus*, with 3 or 4 species, is spread over the whole of the northern part of South America, including Colombia, Venezuela, Guiana, and in the valley of the Amazons as far as Para. Probably the genus spreads into the Brazilian forests, to the south of the Amazons; but there are as yet no data to substantiate this belief. It is at all events absent from the Antilles. This archipelago is peopled by the genus *Admetus* which has been found in Cuba, Hayti, and the Bahamas, southwards to Barbadoes, thence to Trinidad, and over the whole of the area occupied by *Heterophrynus* in South America, and northwards through Central America into Texas and Lower California. The species, however, fall into three well-marked groups, which may perhaps be regarded as of generic value. The first of these, typified by *A. fuscimanus* (*mexicanus*), spreads from Mexico, Cuba, and the Bahamas to Panama; the second (*A. whytei*) is met with in Texas, Lower California, Mexico, and Nicaragua; the third (*A. palmatus*) ranges from Cuba, through the Antilles into Guiana, Colombia, and North Brazil. The third genus which has been established, namely, *Phrynopsis*, is represented by one or two species met with in Mexico and California.

The second family, the Charontidae, ranges from Southern Burma and the Andaman Islands over the whole of the Indo-Malaysian and Austro-Malaysian Islands as far as New Caledonia and Samoa. So far as is known the species are few in number, and each is the representative of a peculiar genus. *Stygophrynus* and *Catagaeus* have been found at Moulmein in Burma. *Charon* extends from Java, Amboina, and the Philippine Islands through Papua to the Solomon Islands. *Sarax* has an equally wide distribution, and has been obtained in the Andaman Islands, Singapore, Borneo, the Philippine Islands, Papua, and New Britain. *Charinus*, the most easterly representative of the family, occurs in New Caledonia, the Fiji Islands, and Samoa.

The third family, the Tarantulidae, has a far wider distribution than either of the preceding two. It spreads over the whole of Africa south of the Sahara, from Senegambia and Abyssinia to Cape Colony, along the south of Arabia from Aden to Muscat, from Bombay southwards into Ceylon and turns up again in Siam, but, so far as is known, does not overlap the range of the Charontidae. Oddly enough, however, the group seems to be represented in South America, according to the independent testimony of two authors. Three genera are recognisable, namely *Titanodamon*, with two or three species, ranging from Senegambia to the Congo in West Africa; *Tarantula*,



Map illustrating the geographical distribution of the Amblypygous Pedipalps.

with about four species, is spread over Eastern Africa from the Mozambique to Abyssinia, in South Arabia, India, Ceylon, and Siam; *Damon* (*Nanodamon*), with two, perhaps more, species occurring throughout East Africa from Cape Colony to Somaliland and South Arabia; in South America, one species has been recorded by Perty from Brazil, another by Simon from Patagonia, a little farther south than the 50th parallel of South latitude, that is to say in about the same latitude as the Falkland Islands.

From these data it appears evident that three geographical regions must be admitted for the Tailless Pedipalps. First the Neotropical, characterised by the Admetidae and one genus of the Tarantulidae, which, however, also occurs in East Africa. This region comprises part at all events of Lower California, of Texas, and probably Florida, the

whole of Central America (with the possible exception of the Mexican plateau), the Bahamas, the West Indies, the tropical parts of South America, and even as far south as Patagonia. This region seems divisible into three sub-regions—the Central American, characterised by the genus *Phrynopsis* and the species of *Admetus* of the *whytei* and *fuscimanus* type, and by the absence of *Heterophrynus* and of the species of *Admetus* of the *palmatus* type. It comprises Central America with part of Lower California and of Texas. Secondly, a Brazilian sub-region containing all the countries of South America to the north of the Amazons, and especially characterised by the presence of *Heterophrynus*. Species of *Admetus* of the *fuscimanus* type invade the western side of this sub-region from Central America, and species of the *palmatus* type, abundant in the West Indies, are also spread throughout the area. Thirdly, an Antillean sub-region seems recognisable owing to the absence of *Heterophrynus* and *Phrynopsis*, the scarcity of species of *Admetus* of the *whytei* and *fuscimanus* types, and the presence of those of the *palmatus* type, which, although also occurring in the Brazilian sub-region, seem to be absent from Central America. To the south of the Brazilian sub-region, a Patagonian sub-region characterised by the absence of Admetidae and the presence of *Damon*, one of the Tarantulidae, may be recognised. This sub-region extends far to the south in Patagonia, but its northern limit is as yet unfixed.

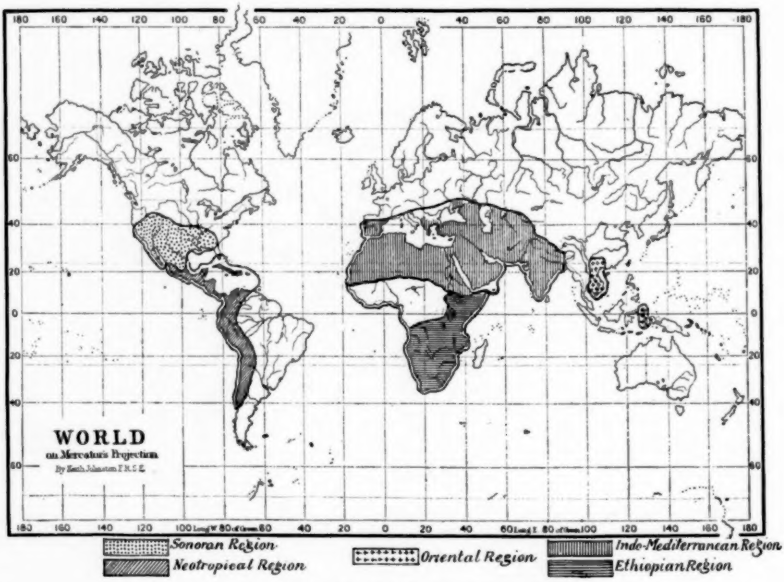
The second region, easily recognisable, may be termed the Malayo-Papuan. It is characterised by the Charontidae, and extends, so far as is known, from Burma in the west to New Caledonia and Samoa in the east, including all the islands of the Indo- and Austro-Malayan areas, but not, so far as has been ascertained, any part of Australia or New Zealand.

And lastly, there is in the Old World the area occupied by the Tarantulidae, comprising Africa south of the Sahara, South Arabia, India, Ceylon, and Siam. For this region the term Indo-African may be applied. The distribution of the genera of this family seems to warrant the recognition of two sub-regions—a western or African, characterised by the presence of the genera *Titanodamon* and *Damon*; and an eastern or Indian, characterised by the almost complete absence of the last-named genera and the presence of the genus *Tarantula*. This sub-region will comprise South Arabia, India, Ceylon, and Siam. The extension of the genus *Tarantula* into East Africa and of *Damon* into Arabia forbids the ascription to these areas of a greater than sub-regional importance.

Distribution of the Solifugae.

The Order Solifugae is divisible into three families:—The Hexisopodidae contains the single genus *Hexisopus* peculiar to South Africa.

The Galeodidae also contains a single genus, *Galeodes,* which has a wide range, extending from the steppes of Southern Russia and Turkestan into Afghanistan, Persia, Baluchistan, India (as far as Madras and Bengal), all over Asia Minor, and even into Greece; also throughout Arabia; and in North Africa, from Egypt to Algeria along the north coast, and southwards through Nubia and Abyssinia into Somaliland. The third family, or Solpugidae, is far richer than the others in numbers, both of genera and species. The following genera are recognised:—*Rhagodes* (*Rhax*), with a range equal in extent to that of *Galeodes* although it is not met with in Greece and Russia, but extends



Map illustrating the distribution of the Solifugae.

in the Saharan region as far as Senegal, and has one reputed species from Ceylon; *Solpuga* (*Zeria*), ranging throughout Africa from Algeria and Egypt to Cape Colony, but attaining its maximum development to the south of the Sahara; *Zeriassa,* nearly allied to the preceding, and occurring in Masailand and Somaliland; *Ceroma,* ranging from Masailand to Cape Colony; *Biton,* found in Syria, Egypt, Tunis, Arabia, and Nubia; *Blossia,* in Lower Egypt and Aden; *Paracleobis,* in Spain, Cape Verde, Somaliland, Socotra; * *Gylippus,* in Syria; * *Gnosippus,* in Egypt; * *Barrus,* in Lower Egypt, and * *Gluvia,* in Portugal; * *Dinorhax,* in Siam and the Moluccas; * *Daesia,* in Mexico; *Datames,* in Colorado, Utah, Nevada, Arizona, Arkansas, Texas, and the Mexican plateau, and

* The genera marked with an asterisk are unknown to me in nature, and I cannot speak with certainty as to their true taxonomic position.

possibly Western Asia (the Caucasus); *Cleobis*, Guatemala, Jamaica, Cuba, Florida, St. Vincent, Colombia; * *Zerbina*, Colombia; *Mummucia*, Peru, Chili, and the Argentine.

In the eastern hemisphere these Arachnida seem to be distributed over three recognisable regions, the Indo-Mediterranean, the Ethiopian, and the Malayan. The Indo-Mediterranean contains Spain, Greece, and South Russia; the whole of North Africa north of a line running from Senegambia on the west to the desert part of Masailand and Somaliland on the east; and in Asia, Asia Minor, Arabia, Persia, Turkestan, Baluchistan, and practically the whole of peninsular India as far to the south as Madras. This region, the richest in genera, is characterised by the occurrence of *Galeodes*, *Rhagodes* (*Rhax*), *Biton*, *Blossia*, *Paracleobis*, *Gylippus*, *Gnosippus*, *Barrus*, and *Gluvia*.

The Ethiopian region, including Africa south of Senegambia and Somaliland, is characterised by the absence of the genera mentioned above and by the presence of the genera *Ceroma* and *Hexisopus*, which are peculiar, and by a host of species of *Solpuga* (including the nearly allied form *Zeriassa*), of which one or two extend into the North African part of the Mediterranean region. No Solifugae have been recorded in West Africa between the Congo and Sierra Leone; but on the eastern side of the continent the Ethiopian fauna blends with that of the Mediterranean area, owing, presumably, to the northern and southern migration of representative genera.

Apart from India, which, possibly with the north of Ceylon, forms part of the Mediterranean region, we know very little, except on the negative side, of the Solifugae of the Oriental region. The only genus that has been recorded is *Dinorhax*, with possibly two species, one in Annam and Cochin China and the other in the Moluccas. No doubt the genus will turn up elsewhere in the islands of Indo- and Austro-Malaya, and probably considerably farther to the north in the Chinese area; and since all the types recorded elsewhere seem to be entirely absent, this area may be termed the Malayan, and be regarded as of regional importance.

The species inhabiting America are distributed so as to admit of the recognition of two regions—a northern or Sonoran, characterised by *Datames*, and probably *Daesia*, and comprising the Western and Southern States from California to Texas and part of Mexico; and a southern or Neotropical, comprising Central America, with the possible exception of the Mexican plateau, the West Indies, and Florida and the Andean chain in South America as far as Chili and the Argentine, the representative genera being *Cleobis*, *Zerbina*, and *Mummucia*, all of which are apparently closely related.

* The genera marked with an asterisk are unknown to me in nature, and I cannot speak with certainty as to their true taxonomic position.

General conclusions concerning the Distribution of the Scorpions, Pedipalpi, and Solifugae.

The available evidence indicates that the Scorpions and Pedipalpi originated in early Palaeozoic times (the Solifugae perhaps later) in the northern hemisphere, and enjoyed a wide range throughout this portion of the globe, migrating from the eastern to the western side, or *vice versâ*, by a land connection across what is now the North Pacific or North Atlantic, possibly by both routes. Their absence at the present day from the whole of the extensive areas that lie to the north of the 40th or 45th parallels of North latitude, is probably to be attributed to the refrigeration of the northern hemisphere during the glacial epoch.

If this view of their northern origin be correct, these Arachnida must have migrated southwards into the southern lands they now inhabit; but since their palaeontology furnishes no help in determining the dates of their migrations, it is necessary to appeal to the evidence supplied by the Vertebrata, and especially the Mammalia, with regard to the past history of the southern continents.[1]

It is considered probable that the ancestors of the existing Afro-Mascarene Mammals fauna entered the Ethiopian region some time during the Oligocene period, when Madagascar was united to South Africa; that during Pliocene times Madagascar was separated from the mainland, and a more intimate union between Africa and Asia, by way of Syria or Arabia, admitted the more highly organised ancestors of the existing ungulates, monkeys, etc., which were thus cut off from Madagascar by the Mozambique channel.

The fact that scorpions belonging to the Buthidae and Ischnuridae, allied to but distinct from the African species, occur in Madagascar, shows that, like the lemurs and the viverrines in the case of the Mammals, representatives of these families inhabited South Africa before the submergence of the land connecting it with Madagascar. Similarly, the absence from this island of the Amblypygous Pedipalpi, of the Solifugae, and of all the African genera of Buthidae and Scorpionidae, points to the conclusion that these forms entered Africa after the separation of Madagascar. Thus, so far as these Arachnida are concerned, the scorpions were the pioneers in taking possession of Africa.

There is no evidence against the hypothesis that these incursions synchronised with those of the Mammalia. On account of the very great antiquity of the scorpions, as compared with the Mammalia, it might be considered probable that the former anticipated the latter in their southward movement into Africa. But, it must be remembered, there is no evidence that scorpions of the kind found in the

[1] In this connection I have specially consulted Mr. Lydekker's "A Geographical History of Mammals. Cambridge, 1896."

Carboniferous beds (Anthracoscorpii) survived that period, and none that the group of Neoscorpii, which comprises all recent forms, had come into existence at that time. Hence it is possible that the latter only date back to the earlier Secondary epoch. They may, in fact, be coeval with the Mammalia. If this be so, the similarity in distribution between the two classes is not a surprising fact.

It is believed by Dr. Blanford that India was connected with South Africa, by way of the Seychelles and Madagascar, throughout Upper Cretaceous (perhaps during Eocene) times, and that the connecting land was broken up into islands at an early date in the Tertiary period. This view is in accordance with the suggestion already made, that the scorpions took possession of the Afro-Mascarene continent during the Oligocene and Miocene epoch, that is to say, after the severance of Madagascar from South India. Otherwise there would be, one may suppose, a much greater resemblance than actually obtains between the scorpions of Indo-Ceylon and Madagascar. Clearly also the absence of Indian scorpions and of Amblypygous and Uropygous Pedipalps from Madagascar, and their presence in South India and Ceylon, shows that they entered these areas of the Oriental region after the submergence of the land uniting this region with the Mascarene portion of the Ethiopian; in other words, not before, and probably after, the Eocene period.

It is stated by Mr. Lydekker that during the Pliocene India and Africa were zoologically identical, the identity being due to the derivation of the mammalian population of the two countries from a common source, namely, the so-called Siwalik fauna of Lower Pliocene age, which has been traced from the frontiers of Baluchistan along the Himalayas into Burma, and for some distance to the north, south, and east of that country. Here, again, there appears to be no evidence against the supposition that the ancestors of the existing Indian, and most of the existing African, Scorpions and Pedipalps, also formed part of the Siwalik fauna. At all events, as a working hypothesis this may be assumed to be the case.

If the Amblypygous Pedipalp of the genus *Tarantula* was widely distributed over the area occupied by the Siwalik fauna, its existence at the present day in Siam, India and Ceylon, Arabia, and East Africa becomes intelligible, because it appears certain that in Pliocene times there was a broad, and in part forest-covered, tract of land uniting Africa with South-Western Asia. Probably the scorpions of the genera *Iomachus* and *Archisometrus*, both of which occur in India and East Africa, entered the latter area at the same time as *Tarantula*.

So far as the genera just mentioned are concerned, the fauna of Africa and India are at the present time identical. The differences between the two that obtain in other respects appear to be explicable on the hypothesis that new forms have sprung up within two areas since the Pliocene epoch, and that others, like the scorpions of the

genera *Scorpiops, Chaerilus,* and *Isometrus,* and the Pedipalps of the family Thelyphonidae never succeeded in reaching Africa.

This Pliocene incursion into India took place before the separation of Ceylon. After the occurrence of this event India seems to have been invaded from the north-west, by way of the Punjab and Sind, by its existing genera of Solifugae (*Galeodes* and *Rhagodes* (*Rhax*)), and by the scorpions of the genera *Butheolus* and *Buthus.* These forms occur in abundance in Persia, Arabia, and neighbouring countries, but are absent from Burma and Ceylon.[1]

The similarity between Indo-Ceylon and the Indo-Malaya, so far as scorpions and Thelyphonidae are concerned, proves either a more intimate union between the two than at present obtains, or a common source in the north, whence a simultaneous southward migration into the two areas took place. Since there is no evidence to be drawn from other sources in favour of the former supposition, the latter may be adopted as furnishing an explanation of the facts. In that case we may conceive that the common source was the Siwalik fauna, which, as has been explained, has left mammalian traces in Burma, China, and various parts of Indo-Malaya (Java, Sumatra, the Philippines).

But whether this be so or not, the extension of the scorpions *Hormurus, Isometrus,* and *Archisometrus,* and of Pedipalp *Thelyphonus* right away from India and Burma, and of Amblypygous Pedipalps of the family Charontidae from Burma to Papuasia, or even North-Eastern Australia, shows that there was at that time no barrier to migration between Indo-Malaya and Austro-Malaya. In this respect the Arachnida offer a striking contrast to the Siwalik mammals, which for the most part did not cross "Wallace's line."

Nevertheless from the absence of the Pedipalpi and Solifugae from Australia, it seems evident that this continent, with the exception, perhaps, of its north-eastern portion, was separated from the countries lying to the north of it at the time when the Arachnida in question entered Papuasia. Two of the typically Oriental genera of scorpions, namely, *Isometrus* and *Archisometrus,* are met with in Australia, it is true; but with these exceptions, the scorpions of this area are strikingly different from those of the Oriental region. There is one peculiar genus of Buthidae, *Isometroides;* a second peculiar genus is *Cercophonius,* belonging to the Bothriuridae, a family elsewhere occurring[2] only in South America, where it has many genera and species. A third peculiar genus is *Urodacus,* the type of a special family or sub-family belonging to the same section of the Order as the Scorpionidae of India, Malaysia, and South Africa.

[1] One species of *Rhagodes* has been recorded from Ceylon; but the accuracy of the locality appears to me to be doubtful.

[2] An example of this group has been recorded from Sumatra; but since the specimen appears to be specifically identical with a form common in the Argentine, there can be little doubt that it was not taken in Sumatra. The opportunity of examining this species I owe to the courtesy of M. Simon.

It is impossible to fix the date of the occupation of Australia by the ancestors of these peculiar forms; but if the existing Pedipalp and Scorpion fauna of Indo- and Austro-Malayan spread over this archipelago in the Pliocene period, as has been supposed, it is clear that the ancestors of the Urodacidae must have entered Australia in pre-Pliocene times. Hence it is possible that their entry synchronised with that of the primitive marsupials, and this is believed by Mr Lydekker to have taken place in the Eocene epoch. This author further believes that the similarity between the existing Australian and the extinct Patagonian Dasyuridae (Marsupials) is to be explained on the hypothesis of a land connection in Tertiary times between Australia and South America. This hypothesis would also account for the occurrence in Australia of *Cercophonius*, which belongs to a typically Neotropical family.

In Palaeozoic times it appears that the Scorpion and Pedipalp fauna of North America and of Europe was practically identical, and, judging from the available evidence supplied by the extinct mammals and reptiles, it is permissible to suppose that the similarity extended throughout the Jurassic and Cretaceous epochs. Moreover, during the Tertiary period there must have existed between the eastern and western portion of the northern hemisphere a northern land connection, admitting a free interchange of the more northern representatives of the fauna, at all events during the prevalence of sub-tropical conditions. Nevertheless, even during the time when the northern union was completest and the conditions of temperature most favourable for an interchange of species, we should expect the fauna to become gradually more and more distinct in the eastern and western moieties of the northern hemisphere the farther to the south it extended. These differences would become still more marked with the stoppage of all intercommunication and the destruction of the northern forms with the advent of glacial conditions in late Tertiary times. It seems, in fact, unnecessary to look further afield for an explanation of the generic differences that distinguish the scorpions, whip-scorpions, and Solpugas of the Southern States of North America from the most northern representative of these groups in Europe and Asia.

This leaves the question of the origin of the fauna of South America to be accounted for.

It is held by geologists that South America was separated by sea from the southern portions of North America in the Jurassic and Cretaceous eras, and that the separation, which was probably continued through the Eocene, came to an end by the end of the Miocene. If, then, the ancestors of the existing Scorpions, Pedipalpi, and Solifugae entered South America from North America they must have done so either before the Jurassic epoch or during or after the Miocene. But it appears to me that the structural differences between the South American Arachnida and those of the rest of the world are not of

sufficient importance to warrant the belief that they have been isolated during the enormous length of time that has elapsed since the Jurassic epoch. The species of Thelyphonidae, Solifugae, and most of the scorpions, for example, are only generically different from their old world allies; and, although the scorpions of the family Bothriuridae are, with the exception of the Australian genus *Cercophonius*, peculiar to the region, they are, in my opinion, merely a specialised group descended from the American members of the Vejovidae (Iuridae), a family which at the present time is represented by genera in the Mediterranean and Oriental regions, in California, Mexico, Bolivia, and Chili. It is mainly to the south of the area occupied by the Vejovidae in South America that the Bothriuridae occur in force, and their structure and distribution suggest that they became gradually differentiated as the Vejovidae spread southwards into South America. Fortunately the survival of the Vejovidae has left a clue to the origin of the Bothriuridae.

So, too, in the case of the tailless Pedipalpi of the family Admetidae, which are confined to the region. The structural peculiarities of the genera seem hardly important enough to justify the view that they have been isolated since the early portion of the Secondary epoch; and the supposition that the eastern and western representatives of the Amblypygi were probably cut off from intercommunication with each other at an earlier date than were the scorpions, whip-scorpions, and Solifugae, is supported by the fact that at the present time they do not extend to the north of the Tropic of Cancer in the Old World, and scarcely surpass it in the New. This would lead to an earlier differentiation of the genera on the two sides of the Pacific, and the differences would go on increasing during the gradual refrigeration of the northern hemisphere, which culminated in the glacial period, when the Pedipalps in question were probably exterminated as far south as a line represented by the northern tropic, and the northern ancestors of the Admetidae were blotted out.

If, however, the view that the Neotropical scorpions, Pedipalpi, etc., did not enter South America in pre-Jurassic times be rejected, it still remains to be seen whether any other country than North America can be looked upon as the source that has supplied South America with its fauna.

On palaeontological and geological grounds it is believed by Mr. Lydekker that the ancestors of the mammalian ungulate fauna of South America migrated from South Africa by means of a land connection in Tertiary times, a small contingent of marsupials crossing in the same way and during the same epoch from Australia. This migration of African and Australian forms took place before the northern irruption of the higher mammals, such as cats, bears, llamas, etc., into South America in post-Miocene times; and since, as is believed, the ancestors of the existing population of African eutherian mammals and of Australian

marsupials entered their respective areas of distribution in Eocene times, the lands connecting these two continents with South America must, according to the hypothesis, have been in existence some time between the Eocene and the end of the Miocene periods.

Apart, however, from dates, since land connections between the areas in question are believed to have existed, it is necessary, when discussing the question of the origin of the Neotropical scorpion and Pedipalp fauna, to examine the evidence for or against the view that any elements of the fauna have been derived from Australia or South Africa.

Since the Solifugae and the two groups of Pedipalpi with which we are dealing do not occur in Australia at the present time, and there is no reason to suppose they have existed there in the past, the question of the Australian origin of the Neotropical members of these orders need not be further discussed. But seeing that both Amblypygous and Uropygous Pedipalps extend in Polynesia as far as Samoa, it may be deemed possible that they passed into South America by a land connection in more northern latitudes. No justification for this hypothesis, however, is supplied by the existing fauna.

With regard to the scorpions, the question of a trans-Pacific migration bears a different aspect. As already stated, the Australian genus *Cercophonius* belongs to the typically South American family Bothriuridae (Telegonidae). Hence Australia may have supplied South America with this portion of its fauna. But, *ceteris paribus*, the migration may equally well have taken place the other way, that is to say, from South America to Australia, and this view of the matter is supported by the richness of the Neotropical and the poverty of the Australian fauna in genera and species of this family. If this supposition be correct, and if the assumption already made, that the ancestors of the Neotropical Bothriuridae did not enter South America before the end of the Miocene be also correct, there must have been a land connection between the two countries, probably in Pliocene times. It seems evident, however, that New Zealand formed no part of this trans-oceanic continent.

Turning now to Africa, it is clear that since the Thelyphonidae do not exist in that country, the Neotropical genera of the group cannot have come from there. The Neotropical Solifugae, too, are in no way closely related to the Ethiopian members of this Order, but to those of the Mediterranean region, and no special relationship is traceable between the African Amblypygous Pedipalpi of the family Tarantulidae and the Neotropical Admetidae. The scorpions, too, of the two regions are, on the whole, very distinct. There is, however, one genus of scorpions, *Opisthacanthus*, which at the present time is found only in tropical Africa, Madagascar, and South America, and one genus, *Damon*, of the family Tarantulidae, which occurs only in East Africa and South America.

The occurrence of the genus *Opisthacanthus* in Madagascar as well as in South Africa, indicates that it entered Madagascar before the

severance from Africa was effected, and, according to our hypothesis, this migration took place in Oligocene times. Hence, if a land connection between South Africa and South America existed at any time during or after the Oligocene, scorpions of this genus might have crossed from one continent to the other. That Africa and not South America was the original home of the genus is shown by the existence of many species in the former country and of many allied genera in the same and other areas of the Old World, while the single species that South America possesses is the only representative of the family found in the New World.

The same line of argument might be adopted to explain the occurrence of the Pedipalp *Damon* in the Ethiopian and Neotropical regions, were it not that the genus is not known to inhabit Madagascar. Possibly it may in the future be found in this island, but if not, its absence, as already shown, will indicate that it entered or became evolved in South Africa after the formation of the Mozambique channel; and since this event is believed to have taken place about the Plicoene period, and assuming the present distribution of *Damon* in South America and South Africa to be due to the existence of a southern land connection between the two continents it inhabits, it seems clear that the connecting bridge had not subsided, at all events, before the beginning of the Pliocene.

The available evidence then seems to show that the Neotropical region owes the bulk of its fauna to North America, and that certain elements in it may have come from South Africa. Again, the evidence appears to me to be in favour of the hypothesis that it was peopled with the ancestors of its existing species of scorpions, Pedipalps, and Solpugas during the Tertiary epoch.

The West Indies seem to have acquired their fauna from two sources. The Solifugae and Thelyphonidae probably came from Central America *viâ* Cuba; and a land connection between this island and Yucatan is believed to have existed in the Pliocene and probably in the Plistocene as well. Some of the scorpions and the species of *Admetus* of the *fuscimanus* type appear to have travelled by the same route; while other scorpions and the species of *Admetus* of the *palmatus* type seem to have entered the sub-region from the south *viâ* Venezuela or Guiana.

In a paper upon the geographical distribution of scorpions already referred to, I pointed out that the area of the earth's surface to which these animals are now restricted might be divided into the following regions:—

1. MEDITERRANEAN, including South Europe, North Africa from Senegambia to Nubia, Arabia, Asia Minor, Persia, Afghanistan, etc., and North-Eastern China.
2. ETHIOPIAN, including Africa south of Senegambia and Nubia, and Madagascar.

3. ORIENTAL, including India, Ceylon, Burma, and the countries and islands east and south-east of this point as far as "Wallace's line."
4. AUSTRALIAN, including the Australasian islands east of "Wallace's line" and Australia.
5. SONORAN, including the Southern States of North America south of about the 40th parallel and the central plateau of Mexico.
6. NEOTROPICAL, including the rest of Central America, the West Indies and South America, nearly as far south as the 50th parallel of latitude.

Subsequent studies in the same group have not materially affected these conclusions. But the discovery that species of typically Arabian and Persian types extend as far as Gwalior in India will make it necessary to draw the line of demarcation between the Mediterranean and Oriental regions considerably to the east of the Indian frontier.

The known facts connected with the distribution of the Solifugae and the Pedipalpi agree in the main with those that the scorpions supply. A notable exception is furnished by India, which, while clearly belonging to the Oriental region so far as scorpions and whip-scorpions (Uropygi) are concerned, forms part of the Mediterranean region in the case of the Solifugae, and of the Ethiopian in the case of the Amblypygi. Taking the four groups into consideration, however, the balance of evidence is in favour of classifying it with the Oriental region. On the other hand, the Austro-Malayan Islands, which in the case of the scorpions were referred to the Australian region, belong, in the case of both Amblypygous and Uropygous Pedipalpi, and also in the case of the Solifugae, if the record of *Dinorhax* from the Moluccas be correct, to the Oriental region without doubt; and since, even in the case of the scorpions, these islands are perhaps as much Oriental as Australian, the evidence points to their inclusion in the former region.

One last word about the Sonoran region. The absence of any barrier between this region and the Neotropical makes its exact southern limit a matter of doubt, on account of the intermixture of the faunas of the two areas. The genera that may be regarded as characteristic of the region are *Hadrurus, Vejovis, Uroctonus,* and *Anuroctonus* amongst the scorpions, and *Datames* amongst the Solifugae. These forms extend into Mexico, but are absent from the West Indies. But the region also contains species of Uropygous and Amblypygous Pedipalpi, scorpions of the genera *Diplocentrus* and *Centrurus,* and probably Solifugae of the genus *Cleobis.* Since, however, these genera extend far into the Neotropical region, and are met with in the West Indies, they must be regarded as Neotropical elements, which have pushed their way to the north since the final union between North and South America took place.

Protoplasmic Currents and Vital Force.

By Prof. A. L. Herrera.

I have lately stated that some currents of granules may lead to the formation of a pseudopodium in my synthetic protoplasm observed under the microscope.[1] What occurs is an exact imitation of the natural phenomenon. The internal energy of the said currents expends itself in external movements. The fluid loaded with granulations strikes, as it were, a blow as it dashes against the endosarc, or the limiting membrane of the protoplasm, and pushes it outwards.

But these currents play a more important part; they induce, indeed, the following processes:—

1st. Renovation of the surfaces of contact between the oxidisable parts and the external oxygen. More effective elimination of carbon dioxide.[2]

2nd. Conveyance of the nutritive particles and residues. Nutrition of the masses of alveolar protoplasm, which fulfil the functions of glands, etc., according to principles of Van't Hoff, Becquerel,[3] and Loeb. Circulation of the reserves and circulation in the zymoses.

3rd. Deposition of certain materials and separation of some others according to their solubility, density, and so forth. Concentric formations, incrustations, etc.

The study of these internal currents is, one may say, the chief aim of physiology. They may be explained in terms of known physico-chemical causes rather than by an undiscovered and undiscoverable vital force. The causes are—

A. Diffusion and osmotic currents.

B. Heat. Oxidations.

C. Ingestion of the materials that support the phenomena of diffusion and oxidation.

D. Partial vacua and changes of every kind in internal pressure, induced by evaporation, etc.

[1] *Natural Science*, August 1898; *Bull. Soc. Zool. France*, 1898, p. 119; *American Naturalist*, December 1898.

[2] See A. L. Herrera and D. Vergara Lope, "New Theory of Respiration." Congress at Moscow, 1898.

[3] Becquerel, "Les forces électro-capillaires dans les phénomènes de nutrition" *Comptes rendus Acad. Sci. Paris*, 15 février 1875.

The action of these causes may be tested by both the natural and the synthetic protoplasm.

A. The use of gummy water is indispensable if one wishes to observe the circulation of protoplasm in the elements of trees, and the movements are generally dependent on the conditions of diffusion (cf. Bütschli's foams).[1] The currents of the artificial product vary in accordance with the diffusive power of the substances, the quantity of liquid, and the presence of some large granulations.

B. The rapidity of diffusion increases, within certain limits, with an elevation of temperature (Graham). The movements of the protoplasm increase in rapidity between 10 and 22 degrees, becoming slower beyond those limits, and stopping between 45 and 48 degrees.

I have seen that at a suitably high temperature these currents present themselves even in very viscous liquids. It is evident that oxygen as well as the liberation of heat attendant on respiration are equally necessary to every being.

C. The paralysis of artificial currents ceases completely with an addition of peptone or a new quantity of salts.

D. This is an evident principle. It is enough to remember the facts concerning the circulation of sap and blood. The paralysis of internal currents stops life everywhere, decomposition coinciding with an absolute diminution of movement.

The rapidity of the course of blood through the capillaries is identical with that of the currents of protoplasm, and varies likewise according to conditions, its result being the same—nutrition and life.

A motionless peripheral layer of serum is observed similar to that apparent in the currents of pseudopodia.

The difference between latent and oscillating life lies, in short, in the almost absolute or simply partial inhibition of the internal currents. Water, heat, and oxygen are required as in a physico-chemical phenomenon, and I have often suspended the currents in my protoplasm by means of desiccation or refrigeration for months together. There is then another argument against my theory which regarded movements as a result of the discharges of carbon dioxide—a theory which has certainly been for me a source of fertile suggestion, though I have now given it up.

The importance of a large quantity of water in internal currents is perfectly demonstrated. I have shown that dilution has a great influence on the rapidity of the granulations in my artificial protoplasm.

Now, the gray substance contains more water than the substance in the cerebellum, and this has more than the white substance of the brain and medulla (R. Dubois). The neuroplasm has doubtless its currents, and the variations exhibited in their rapidity, as well as the shocks of their molecules and the waves produced, perchance, by the passage of the current from a conductor with a big calibre to a thinner

[1] See Milne-Edwards, "Anatomie et physiologie comparée," tome v. p. 105.

one, may result in certain nervous and continuous actions or sensations, external stimuli provoking the vibrations, as I have studied in mercury.[1] On the other hand, Dubois says that anaesthetics produce the expulsion of internal water, and I have observed that exhalations of ether have the property of energetically repelling any thin layers of water ("On a Property of Ether," *Memorias y Revista Sociedad Alzate*, 1895-96, Nos. 5, 6, p. 33). This means that anaesthetics modify the rapidity of the currents or even succeed in completely preventing them.

The action of alcohol on my artificial product is curious, there being a remarkable excitation of the movements followed by their absolute paralysis.

In the sea-urchin egg, says Dubois, segmentation can be prevented by hindering hydration by the addition of salt at 2 per cent. to the sea water. When segmentation has already begun it stops in a strongly salted medium, but it pursues its course directly after some normal water is poured on it; and, what appears more notable, it then continues with increased rapidity. I have observed analogous phenomena in my artificial protoplasm.

In a word, the protoplasmic currents have a constructive or formative action comparable to that wrought by rivers on the earth's surface.

Contractile vacuoles can be explained by an augmentation of tension promoted by some endosmotic currents. The former may be imitated by alternatively stretching and relaxing a plate of gluten.

Life ought not to be likened to a continuous chemical reaction, the mechanism of which remains involved in darkness and unexplained. Life is now to be defined as the result of the physico-chemical action of protoplasmic currents, the cause of such currents being diffusion, heat, and some other secondary factors. Death consists in an absolute suspension of the internal currents in general; latent life is characterised by the establishment of the said currents under the influence of oxygen, heat, and water, in a germ or organism having the structure and chemical elements necessary, and supplied with every nutriment required. Oscillating life is nothing more than an alternate contribution and reassertion of the constructive internal currents, depending upon the variations of the external temperature. Every physico-chemical or mechanical action capable of affecting the rapidity, direction, and other characters of internal currents must have more or less influence on the phenomena hitherto considered as vital.

MEXICO, *January* 9, 1899.

[It may be recalled that the artificial protoplasm to which the author so often refers is an emulsion of albuminoid, etc., made according to Reinke's analysis of "Flowers of Tan." In expounding his conclusions Professor Herrera is at a disadvantage in writing in a foreign tongue; and we may also note that he is also hindered in his researches by the lack of an adequately powerful microscope.—ED. *Nat. Sci.*].

[1] *Natural Science*, December 1898.

FRESH FACTS.

THE SHELL OF A TURTLE. H. GADOW. "Orthogenetic Variation in the Shells of Chelonia," *Proc. Cambridge Phil. Soc.* x. 1899, pp. 35-37. The normal shield of the Loggerhead turtle (*Thalassochelys caretta*) possesses six median (including the so-called nuchal) and five pairs of costal scutes. Of a total of 56 specimens not less than 43 were abnormal, *i.e.* 76·6 per cent. Of 41 newly-hatched specimens not less than 38 were abnormal, *i.e.* 92·7 per cent. The variations are manifold, the number of median scutes varying from 8 to 7 to 6, the costal scutes ranging from 7 to 6 to 5, and they are either symmetrical or uneven. Most of the individuals seem to grow out of these irregularities, which the author regards as "atavistic reminiscences," and the reduction or squeezing-out of the supernumerary scutes proceeds in a very regular way, suggestive of "orthogenesis," it seems.

POISON OF CENTIPEDES. O. DUBOSCQ. "Sur l'histogenèse d ı venin de la scolopendre," *Arch. zool. expér.* vi. 1898 (Notes et Revue) pp. xlix-li. Part of the poison is formed in the nuclei of the glandular cells at the expense of the chromatin, a histological result which agrees with the chemical one that certain active components of poisons are nucleo-albumins.

SECRETION OF POISON IN THE ADDER. W. LINDEMANN. "Ueber die Secretionserscheinungen der Giftdrüse der Kreuzotter," *Archiv mikr. Anat.* liii. 1898, pp. 313-321, 1 pl. The process of venom-secretion is closely analogous to that in an ordinary salivary gland. Homogeneous drops appear in the cell-substance which becomes clearer. The periphery becomes darker as the drops are discharged.

CASTRATING CATERPILLARS. J. TH. OUDEMANS. "Falter aus castrirten Raupen, wie sie aussehen und wie sie benehmen," *Zool. Jahrb.* xii. 1898, pp. 71-88, 3 pls. 2 figs. The experimenter has not only shown that it is possible to castrate caterpillars, which is surprising enough, but that the process has no effect on the external appearance of the adults as regards secondary sex characters, which is even more surprising. Even the habits were little affected, thus copulation occurred though there were no spermatozoa. The organism is indeed a unity, and more than a correlated congeries of parts!

INOCULATION FOR TICK FEVER. C. J. POUND. "Note on Tick Fever in Cattle," *Journ. Quekett Micr. Soc.* vii. 1898, pp. 118, 119. The author claims to have worked out protective inoculation for tick fever. Some thousands of cattle have been inoculated, and the results have proved highly satisfactory, for when such cattle were subjected to gross tick infection, or injected with virulent blood, they remained perfectly immune. But no statistics are given in the brief paper.

HAIRS OF MONOTREMES. BALDWIN SPENCER and GEORGINA SWEET. "The Structure and Development of the Hairs of Monotremes and Marsupials, Part I.

Monotremes," *Quart. Journ. Micr. Sci.* xli. 1899, pp. 549-588, 3 pls. and 6 figs. In all essential respects the development of the hairs in Monotremes is precisely similar to that of other mammals; the early development of the follicle is in the form of a solid epidermic downgrowth, not tubular to start with as Poulton described it.

A PARASITE OF THE BRAIN. ALBERT W. BROWN. "On *Tetracotyle petromyzontis*, a Parasite of the Brain of Ammocoetes," *Quart. Journ. Micr. Sci.* xli. 1899, pp. 489-498, 1 pl. The existence of so highly organised a form as a Trematode in the brain cavity of a vertebrate is a unique phenomenon in many ways, and this must commend *Tetracotyle petromyzontis* to the interest of naturalists. It is, the author says, almost incredible that any vertebrate could live on, apparently without discomfort, whilst its brain is packed with hundreds of flukes. But this is the case.

MORE EXPERIMENTAL EMBRYOLOGY. HENRY E. CRAMPTON, JR. "The Ascidian Half-Embyro," *Ann. New York Acad. Sci.* x. 1898, pp. 50-57, 2 pls. An isolated blastomere of *Molgula manhattensis* segments as if still forming a corresponding part of an entire embryo. The cleavage phenomena are strictly partial; the result is a larva of less than normal size, and with defects in certain of its systems. Mr. Crampton's results confirm the view of Roux, that the development begins as a partial one, but that the missing part is gradually supplied by the cells already present, so that the partial nature of the development is progressively masked, and the end is a nearly complete larva.

INTERCELLULAR BRIDGES. HERMANN KLAATSCH. "Die Intercellularstructuren an der Keimblase des Amphioxus," *SB. Akad. Wiss. Berlin*, 1898, pp. 800-806, 4 figs. There is a well-developed system of intercellular connections persistent to the end of the gastrulation process, if not longer. Ectodermic cells are connected, and endodermic cells are connected, but there is no connection between ectoderm and endoderm except at the transitional zone.

NEW CASE OF PARENTAL CARE IN FROGS. AUGUST BRAUER. "Ein neuer Fall von Brutpflege bei Fröschen," *Zool. Jahrb.* xii. 1898, pp. 89-94, 3 figs. Dr. Brauer found in the Seychelles a small frog (*Arthroleptis seychellensis*) which bore on its (his ?) back nine tadpoles fixed by their ventral surface.

TWO NEW BRITISH MAMMALS.—At a meeting of the Zoological Society of London on February 7, Mr. G. E. H. Barrett-Hamilton, F.Z.S., read a paper on the Mice of St. Kilda, of which he recognised two species—*Mus hirtensis* sp. nov., a representative of *M. sylvaticus*, and *M. muralis* sp. nov., representing *M. musculus*. Both of these species showed good distinctive characters from their well-known prototypes.

SOME NEW BOOKS.

A COMPREHENSIVE WORK ON MOTHS.

Catalogue of the Lepidoptera Phalaenae in the British Museum, Vol. I. Catalogue of the Syntomidae in the Collection of the British Museum. By Sir GEORGE F. HAMPSON, Bart. 8vo, pp. xxi + 559, with 285 illustrations in text, and accompanying volume of 17 plates with coloured figures. London: Printed by order of the Trustees, 1898.

The first volume of this series, the circular relating to which is given in *Natural Science*, vol. xii. 5, is now issued, and will be received with interest by lepidopterists generally. The volume is accompanied by a preface from the Director of the British Museum (Natural History), by a systematic index of the species included, and an introduction of 20 pages from the author. In this introduction the general classification and phylogeny is categorically laid down, and the structure of the Lepidoptera is discussed in a series of brief paragraphs, of which those relating to the ovum, larva, and pupa have been revised by Dr. Chapman and Dr. Dyar. The classification is mainly based upon an interpretation of the neuration. The primary division of Comstock is adopted, and the Micropterygides and Hepialides are opposed to the rest of the moths, because of the 12-veined secondaries, *i.e.* the radius has the same number of branches as on primary wings. More recently *Crinopteryx familiella* has been studied by Spuler and Hofmann. This Tineid represents the final stage in the loss of radial branches, so that a passage is effected between the groups, and the character is vitiated. An ambitious key to the families is given on page 17, in which no use is made of the anal vein of primaries in the Papilionides, while the Satyrids are separated from the Nymphalids by the dilated vein 12. But this vein is dilated in *Potamis iris* (Nymphalidae), and the dilations are reduced in *Agapetes* and *Oeneis* (Satyridae). The more important part of the volume is taken up by the description of the 1184 species of Syntomidae. Purists may write Syntomididae; others, believing the Tentamen edited, and *Glaucopis* being pre-occupied, may prefer Sphecomorphidae, while the Americans use Euchromiadae. The family, from observations on all stages, contains specialised Arctians, the limits of the two groups being obscure. The descriptions, both generic and specific, are concise yet sufficient, but the opportunity of considering the male genitalia has been neglected, which may possibly lead some to regard the work as "superficial." The synonymy often lacks the necessary reference to the author of the combined term adopted, thus breaking the historical sequence (e.g. *Ctenucha virginica*). This fault seems to have been copied, with the citations, from Kirby's catalogue. On page 361 *Burtia* is dated "1867," on the succeeding page "1866," as by Kirby. *Burtia* was published with figure and should have precedence as noted by Moeschler (Lep. Porto Rico, 349), who, however, misplaces the synonym *Gundlachia*. *Horama diffissa*, correctly dated by Kirby, is post-dated, with its synonym, by 20 years. The intention is to include all species agreeing with the family definition. The

figures in the text are recognisable and will be helpful; the coloured figures in the volume of plates merit praise. On Plate X. Fig. 3, not 2, seems to represent *Pseudomya splendens;* such errors are regrettable. The work bears the mark of industry, and can be said to be successfully accomplished, so that the expectation held out in the preface, that it will be of value to the systematic zoologist, may be considered as realised. A. RADCLIFFE GROTE.

THE PHILIPPINES

The Philippine Islands and their People. By DEAN C. WORCESTER. Roy. 8vo, pp. xx. + 529. London: Macmillan and Company, 1898. Price 15s. net.

Professor Worcester first visited the Philippines in 1887, as a member of Dr. Steere's zoological expedition to that group. He remained upwards of a year, and returned in 1890 for a period of nearly three years. He visited all the important islands, remaining in each long enough to form a fairly representative collection of its birds and mammals. In the present work he does not attempt so much to present an account of his zoological work as to draw a picture of life in the Philippines, and of the condition both of the settled districts and of those occupied by various uncivilised tribes. To the latter, many of whom are practically unknown to ethnologists, Professor Worcester devoted considerable attention, and has made valuable observations on their customs and beliefs. Without setting himself to criticise the Spanish administration, he makes it fairly clear that he did not find it ideally perfect in its relation to individuals, or enlightened in its dealings with the economic development of the islands. At the present moment, when these are on the point of passing into American hands, it is important to note that so good an authority expresses the opinion that it is very doubtful if many successive generations of European or American children could be reared in the Philippines. The climate is exceedingly unfavourable to severe and long-continued physical exertion, such as would be necessary to develop the resources of the islands. An important appendix deals exhaustively with these. The soil is of almost inexhaustible richness, and cacao, coffee, guttapercha, Manila-hemp, bamboo, maize, rice, sugar, tobacco, are among the plants of economic importance. The indigenous mammals are somewhat scanty, but many domesticated ones have been introduced. The large European and Australian horses, however, do not stand the climate. Nearly six hundred species of birds are known, including many rare and beautiful ones. Snakes are numerous, and locusts appear every few years. The most destructive insect pest is a larva which bores the stems of coffee bushes, often destroying whole plantations. Numerous species of fish are found, including a curious fresh-water species which appears annually in the flooded rice fields, vanishing in a mysterious way as the fields dry up. The book is well illustrated, and contains a reproduction of an interesting old map of 1744 and a miserable modern one. A. J. H.

MR. RUTGERS MARSHALL ON INSTINCT.

Instinct and Reason: An Essay concerning the Relation of Instinct to Reason, with some special Study of the Nature of Religion. By HENRY RUTGERS MARSHALL, M.A. 8vo. New York: The Macmillan Co., 1898. Price 12s. 6d. net.

Mr. Rutgers Marshall is known to psychologists as the author of a work on "Pain, Pleasure, and Aesthetics." He there puts forth certain views on instinct and its relation to impulse; and these are elaborated and extended in the work before us. His main thesis is that the ethical and religious instincts, of profound importance to the human race, have been rendered innate and hereditary

in consequence of their biological value to the members of a social community. There is much that is interesting in his new book; but many of the positions occupied require more weight of fact and more cogency of argument to render them tenable.

Instinct, as defined by Mr. Marshall, includes not only reflex action but, it seems, cellular response to stimulus. For we are told that all instincts, whether simple or complex, fall under one category, and appear as modes of that simplest of all forms of activity, the reaction of a living cell to the stimulus received from the environment. On the other hand, instinct is taken to include all that is the outcome of innate tendencies. Not only are the ethical, artistic, and religious "instincts" comprised within the definition, but reason itself. At any rate, the "important conclusion" is emphasised that "all of reasoned action must be referred back to instinct action." On these principles it is difficult to see what types of organic action, animal or vegetable, must *not* be referred to instinct. It is questionable whether a technical term of such wide meaning has any definite value.

The term "impulse" is applied to "mental phases which, when we take an objective view, we find to be determined by the inhibition of instinct actions." But the word "obstruction" is sometimes used as the equivalent of inhibition. The former word has a much wider meaning than inhibition used as a technical term. It is not clear whether Mr. Marshall's contention is that impulse is always determined by the inhibitory influence of higher on lower nerve centres, or something else.

If we accept the extravagantly broad definition of instinct as comprising rational action, it is clear that the distinction between hereditary and acquired modes of procedure is a superficial one. Mr. Marshall does, however, take it to some extent into consideration. But he seems too readily to accept as hereditary much that may be handed on by tradition.

The last criticism for which we have space is this. It satisfies Mr. Marshall to assume, that if this or that mode of activity is of what he terms biological value to the race, it has been or is being engrained through heredity. Whether he accepts the inheritance of acquired characters is not clear; but he lays some stress on the distinctively Darwinian factor in evolution. He nowhere, however, adequately sets forth the steps of the process by which those who fail to possess, say, the religious "instinct" are eliminated. C. Ll. M.

BRITISH PARK CATTLE.

White Cattle: an Enquiry into their Origin and History. By R. H. WALLACE. Trans. Nat. Hist. Soc., Glasgow, (2) vol. v. pp. 220-273, illustrated.

If the object of this communication were simply to demonstrate that British Park White Cattle are not the direct survivors of the wild aurochs or ox (not the bison), Mr. Wallace might have saved himself the trouble of writing it, since all competent to give an opinion are agreed on this point. But his main contention seems to be to demonstrate their descent from a white breed imported by the Romans. In this view he follows the steps of Professor M'Kenny Hughes; and it is far from our intention to endeavour to demonstrate either that he is right or wrong, for the sufficient reason that, in our opinion, the evidence is inadequate. All that we propose in the way of criticism is to call attention to what appears to us a misapprehension.

In his summary the author states that the cattle common in Britain was the Celtic shorthorn, the so-called *Bos longifrons*. This animal is stated to have been small and dark coloured. At the time in question the aurochs (*Bos primigenius*) had become exterminated in Britain; while the Celtic shorthorn was domesticated. The Romans had a special breed of white cattle for sacrificial purposes; and such cattle were brought into Britain. It is from these cattle

that the British Park breeds are derived—perhaps with some amount of crossing.

Such appears to be, very briefly, the author's argument. Putting entirely on one side the question of the particular domestic breed from which the park cattle are descended, we at once proceed to our criticism. This is based on our belief that the author does not know what he means by a species. He says[1] that "our common cattle, *Bos taurus*, is *no doubt* a mixed product of extremely numerous and very diverse factors, developed in widely-separated regions. This animal *when wild* was probably hunted by man, but, tamed, it has accompanied him in all his wanderings. Its geological history in Britain, according to Owen, is first a large species of ox, *Bos antiquus*, followed by a somewhat smaller but still stupendous wild ox, *Bos primigenius*, succeeded in turn by an aboriginal British ox of much smaller stature with short horns, *Bos longifrons*." Later on, p. 245, he observes: "Practically we can entirely ignore *Bos primigenius* as a factor in the history of early British cattle, especially of white breeds."

Now the greater part of the above appears to us pure nonsense. What, for instance, does the author mean by saying that our domestic cattle had a very complex origin, and then that it once occurred *wild?* Are different species of wild animals in the habit of producing a mixed breed for the special benefit of man, that he may capture and tame it?

As a matter of fact, there are only two possible origins for European domestic cattle (as the bison and buffalo may be put aside), namely, the aurochs and the extinct Narbada ox of India. And there is little doubt that the honour of parentage belongs to the former. As to the Celtic shorthorn there is no evidence that it was ever a wild animal. Moreover, as it is not specifically separable from *Bos taurus* (typified by the domestic ox of Europe, which is also the type of its genus), and never having been wild, it cannot claim to be termed a sub-species or race. Neither is there any possibility of specifically distinguishing the Plistocene aurochs from the aurochs of the Middle Ages; although as this was a true wild animal it is entitled to rank as a sub-species, *Bos taurus primigenius*. That this *Bos taurus primigenius* was the proximate ancestor of the Celtic shorthorn, and hence the ultimate ancestor of all European breeds, is, we submit, beyond doubt, unless indeed the aforesaid shorthorn fell from the stars or was separately created! In place, therefore, of the so-called *Bos primigenius* having nothing to do with the origin of domestic cattle, we believe it has everything to do therewith. To look to the Indian humped ox as the ancestor of some at least of our domestic breeds does not help matters. Ordinary and humped cattle (although they will readily cross), differ by their form, voice, and habits; and, although some crossing may possibly have occurred in certain districts, there is not a tittle of evidence in favour of this origin, while there is everything against it. If such were the origin, *Bos indicus* would, of course, have to be sunk in the earlier title *Bos taurus*.

One word more and we have done. On page 222 it is stated that Mr. Lydekker favours the view of the origin of British park cattle from white Roman cattle. Now we have a fairly good acquaintance with the somewhat discursive writings of that gentleman, but have failed to find in any of them *bearing his name* authority for such a statement.

DESCENSUS TESTICULORUM.

Studien über Säugethiere. By Dr. MAX WEBER, Professor of Zoology in the University of Amsterdam. Part II. 8vo, pp. 132, with 4 plates and 58 text figures. Jena: Gustav Fischer, 1898. Price 12 marks.

This book follows its first part after an interval of ten years, but even that length of time does not seem too great for the preparation of the mass of infor-

[1] The italics are ours.

mation which it contains, although the author explains that he issued the book on the eve of assuming the leadership of a Netherlands Deep Sea Expedition to the Indian Archipelago.

With the exception of a few pages the work is devoted to a study of the descent of the testicles of mammals, for which the mere collection of the necessary material could not have been accomplished without the exercise of much patience.

At the outset, Dr. Weber gives an admirable summary and criticism of the diverse structures which different writers have included under the term "gubernaculum," and suggests that this word should be allowed to fall into disuse, since "es hoffnungslos ist, das Wort Gubernaculum zu gebrauchen, ohne dass es Anlass zu Missverständnissen giebt." He prefers to use terms which have a precise significance, such as ligamentum testis, ligamentum inguinale (lig. rotundum), conus inguinalis, cremaster sac, etc.

Details are given of dissections of animals representative of all the mammalian orders, followed by chapters, on the position of the testis, the position of the vasa deferentia, the ligamentum inguinale, and the chorda gubernaculi.

In a very interesting table the author distinguishes between (1) mammals whose testes lie at least temporarily external to the true abdominal cavity, and (2) those whose testes remain permanently within the abdominal cavity. To this latter group he applies the name "Testiconda," and again subdivides it into (*a*) those in which the inguinal canal and the ligamentum inguinale are wanting—True Testiconda—and (*b*) those in which the inguinal canal is obliterated to different degrees, and the ligamentum inguinale at the most is still present in rudiment—False Testiconda.

In discussing these conditions Dr. Weber considers that the true testicond mammals acquired the characteristic at a time when the descensus was still in process of evolution, and as yet only a slightly stereotyped arrangement. Among the Marsupials and the majority of Monodelphia this new arrangement improved more and more, the different stages being still existent among recent mammals; while Testiconda became the stereotyped arrangement with isolated ones, others (Cetacea, Dasypodidae) lost the descensus which had already reached completion, and thereby became Testiconda secondarily. From this point of view true Testiconda ought to be regarded as a return to the primitive condition, not as a return to embryonic conditions, although it must be granted that the embryonic condition is a reiteration of the primitive.

The remainder of the book is taken up with three interesting papers on the elephant, in which the construction of its feet, the peripheral organ of smell, and its brain are respectively dealt with. D. H.

A WIDE RANGE.

Biological Lectures, delivered at the Marine Biological Laboratory of Wood's Holl, 1896-97. 8vo, pp. 242, with figures. Boston: Ginn and Co., 1898. Price 8s. 6d.

A Course of Lectures whose aim is merely defined as being the free discussion of "unsettled questions" in Biology, must necessarily, we suppose, allow to individual lecturers considerable freedom of choice. Certainly the eleven lectures contained in the present volume range over a large number of subjects, and treat these from very different standpoints. From the literary point of view two papers are especially noticeable—one by Prof. C. O. Whitman on "Some of the Functions and Features of a Biological Station," and the other on "The Methods of Palaeontological Inquiry," by Prof. W. B. Scott. Prof. Whitman's paper is a charming discussion of the ideal biological station, which incidentally involves scathing criticism of modern methods, and ends in the

building of a fair palace, with lakes and aquaria, experimental gardens and well-equipped laboratories, where the over-specialised worker may once more get into touch with nature. Prof. Scott devotes himself to a description of the methods employed in modern palaeontological research, taking as an example the fossils of the White River beds. These are traced from the moment of their exhumation to the final setting up of the restored skeleton. The paper is illustrated by photographs, some of which are, unfortunately, somewhat spoiled in reproduction, and is an admirable example of what a popular lecture should be—and so rarely is.

The other papers in the volume are of a more technical nature, and in most cases display little attempt at literary effect. Mr. Hermon C. Bumpus has an interesting paper on the variations of *Passer domesticus*, the introduced sparrow. A comparison of 868 American, and the same number of English eggs, showed that the American eggs were much more variable both in colour and in shape than the English, and further, that the mean shape of the American eggs is different from that of the English eggs. The result is interesting, but we wish that Mr. Bumpus had stated the localities from which the eggs were obtained; the American area is obviously somewhat larger than the British area, and this introduces a possible source of error. Another interesting, though speculative, paper by Dr. Arnold Graf on the physiology of excretion is an attempt to explain the phenomena of excretion in leeches on "mechanical" grounds. Two papers on the centrosome, by Miss Foot and Mr. A. D. Mead respectively, are of interest because their authors both reject Boveri's hypothesis of the great importance of the centrosome in cell-division. An elaborate paper by Dr. Conklin on "Cleavage and Differentiation" is marred by the obscurity of the style and want of care in arrangement. The remaining four papers are devoted to a variety of subjects.

As a whole, in spite of much that is good, we confess to finding the volume a disappointment. There is no index, in most cases not even connected lists of references, and the absence of an editor is often painfully apparent. Many of the lecturers seem to us to show lack of discretion both in their choice of subjects and in their treatment of them under the given circumstances. Finally, the very miscellaneous nature of the contents produces a somewhat painful effect, slightly suggestive of Dr. Blimber's establishment. N.

THE COLOURS OF ANIMALS AND PLANTS.

Colour in Nature. A Study in Biology. By Miss MARION I. NEWBIGIN, D.Sc. 8vo, pp. xii. + 344. London: John Murray, 1898. Price 6s.

Miss Newbigin has performed a useful piece of work in placing before us a book upon colour in nature which abounds in fact and is not dominated and rendered ineffectual by theory. Out of fifteen chapters only one, the last, is devoted to theory; and that seems to us to be an exceedingly reasonable proportion. There is perhaps no department of biology in which so extraordinary a disproportion between fact and theory obtains as in that relating to the colours of animals. To give an example, even the first year's student at a medical school has some notion of the complex structure of the visual organs of the insect and crustacean tribe, and the difference from the analogous organs of the vertebrates. His teacher, if he be a wise person, declines to call the former "eyes": he prefers to term them "visual organs," not in the least on the principle of the journalist who writes of "vehicular traffic," and "the devouring element," but simply because he will not prejudge the question of their correspondence with what have been always called eyes, that is, the eyes of vertebrated animals. Yet the reader of any book or article upon colours in animals and plants is requested to believe—or rather it is assumed without any request at all that he *does* believe—that the physiology of the insect eye

and the visual judgments in the "brain" of an insect are precisely similar to those, not merely of a man, but of an educated man accustomed to observe accurately and reason. A person really competent to theorise upon such matters would have to be—as John Evelyn described Edward the Sixth—"stupendiously knowing." The real fact of the matter is, that Miss Newbigin is perfectly right in pointing out that we do not yet know enough of the plainest phenomena of animal coloration. "We cannot," she justly observes, "end a book on colour more fitly than by an appeal for more facts." The authoress herself deals with the main pigments and the physical causes of colour in the animal world. The book is a valuable epitome of such facts, and will doubtless be read by both students and the general public. F. E. B.

A GEOLOGIST'S ALMANACK.

Kalender für Geologen, Paläontologen und Mineralogen. Herausgegeben von Dr. K. Keilhack. Leipzig: Max Weg, 1899. Price 3 Marks.

The second edition of this compact and useful pocket-book is an improvement on its predecessor, and should prove a valuable companion to every active or professional geologist. It contains the following sections: I. The Government Geological Surveys of the world. Every country in Europe has a survey except Greece, Turkey, Servia, Bulgaria, Montenegro, and Holland; in Asia, only India and Japan have one; in Africa, only Egypt, Cape of Good Hope, and the Transvaal; in South America, only Brazil; in North America, Mexico should have been mentioned, but is not; in Australia, New Zealand is included, but the active survey of Queensland is omitted. II. List of teachers of the geological sciences in the colleges of the world. III. Geological, mineralogical, and palaeontological societies. IV. Addresses of the geologists, mineralogists, and palaeontologists of Germany, the Netherlands, Austria, Switzerland, and Hungary. There have also crept into the list a few people in other places, such as London, La Plata, St. Petersburg, and Guatemala. V. The public and private geological, mineralogical, and palaeontological collections of the same countries. VI. Comparative lists of geological formations. This is very incomplete, being confined to Europe, and dealing with that in a partial manner. At least one would expect to find the classical divisions of the British Silurian. VII. Synoptic table of igneous rocks. VIII. The chief characters of the more common minerals. IX. Symbols for crystal faces, according to Naumann, Weiss, and Miller. X. Atomic weights of the elements. XI. History of the names of the chief formations, by J. Walther. XII. Rules for the application of proper names in systematic nomenclature, by H. Potonié. We have no patience with a person who says that the genitive of "Martius" should be "Martiusii." But in this branch of learning the best way of avoiding puerilities is never to use personal names at all. XIII. Short account of the annual gatherings of the German Geological Society, the Oberrhein Geological Society, and the International Congress. XIV. A list, very incomplete, of geologists, mineralogists, and palaeontologists dead since October 1, 1897. XV. Chief measures of length reduced to the metric scale. XVI. Chart of magnetic declination in Europe during 1899. XVII. List of periodicals containing geological papers. XVIII. The geological, palaeontological, and mineralogical literature of 1898 down to the end of November. This, though it contains over 900 titles, and is much to be grateful for, is by no means complete.

There are the usual diary, blank pages, and section paper, as well as a portrait of the late C. W. von Guembel. Considering the great difficulty of attaining accuracy in a work of this kind, we may well compliment the editor and publisher on what they have done for us. B.

PETIT CULTURE.

Bush Fruits. A Horticultural Monograph of Raspberries, Blackberries, Dewberries, Currants, Gooseberries, and other Shrub-like Fruits. By FREDERICK W. CARD, Professor of Horticulture, Rhode Island College of Agriculture, etc. 8vo, pp. xii. + 537, with 113 figures. London and New York: Macmillan and Co., 1898. Price 5s.

The scientific cultivation of fruit, especially of the smaller kinds, has at least in this country not received the attention which it deserves. It may indeed be doubted whether many of those who delight in the autumn wealth of our English hedgerows think seriously of growing the wild species for profit, much less of attempting to improve them. Our American cousins have, however, devoted a considerable amount of characteristic energy to the cultivation of "berries," whether native or foreign, and the present volume is the first of a proposed series of monographs on American fruits.

Professor Card divides his work into four parts, the first of which is devoted to the discussion of the cultural methods best adapted to berries in general, with remarks on marketing and evaporation. The second and third parts are concerned with "brambles" (including raspberries) and "groselles" (currants and gooseberries) respectively, and contain special directions for the cultivation of the various species and varieties. Careful descriptions and figures are provided of the more important pests and diseases, while references to standard works are given for all the species of fungi and insects known to attack the plants concerned.

The book should prove of service to all who are interested in petit culture, whether in America or at home, not only because certain of the species described are native to those islands, but also because similar treatment might with advantage be applied to some of our own wild fruits. J. A. TERRAS.

INTRODUCTION TO PHOTO-MICROGRAPHY.

Photo-Micrography. By EDMUND J. SPITTA, L.R.C.P., M.R.C.S., F.R.A.S. 4to, pp. 163, with 41 half-tone plates and 63 text illustrations. London: The Scientific Press, 1899. Price 12s.

This work will be useful not only to beginners, but also to those accustomed to photo-micrographic work. It discusses the methods employed, the difficulties encountered, and the means adopted to overcome them. Of especial interest are the parts dealing with the covering power of lenses, the best combinations to use under special circumstances, the employment of condensers, the rough estimation of the N.A. of low power lenses, bacterial cultures and slides, and Appendix IX. It is to be regretted that the author makes no mention either of magnesium as an illuminant nor of the methods available in the case of living specimens. A more detailed account of the best methods of producing fine negatives of histological specimens with the highest powers would have added much to the practical value of the work. The figures, with the exception of the histological ones, are for the most part excellent. E. W. C.

THE ANTLERS OF THE CERVIDAE.

Studien über Hirsche (Gattung Cervus im weitesten Sinne). By Dr. H. NITSCHE. Heft 1. 4to, pp. xii. + 102, with 12 pls. and 12 figs. Leipsic: Engelmann, 1898. Price 20 Marks.

The importance of antlers in the classification of the Deer, although somewhat underrated a few years ago, is now fully recognised by naturalists; and it is therefore satisfactory to find a morphologist of Dr. Nitsche's standing taking up the subject in earnest. The range of antler variation has indeed been fully

mastered from a classificatory point of view; and much has been done in homologising the various constituents of these appendages in the different genera and sub-genera. Much, however, still remains to be accomplished in this aspect of the subject, especially as to what extent the antlers of the Old World and New World deer (*Mazama*) are really homologous, and the degree of evolution they had attained when the two groups diverged.

In the present part, which treats solely of antlers, and their relationship to horns, the author takes into consideration abnormal developments of the former appendages, which are discussed with great elaboration and wealth of illustration. But the conclusions to be drawn from these abnormalities are reserved for future consideration, so that it is impossible to formulate, let alone criticise, the author's views until the work is further advanced. As Dr. Nitsche attended the Cambridge Congress last August, he had an opportunity of seeing the collections on which recent English work has been based, and was much impressed by their extent and completeness.

A FIFTEENTH EDITION.

Determinative Mineralogy and Blowpipe Analysis. By GEORGE J. BRUSH. Revised and Enlarged by SAMUEL L. PENFIELD. Fifteenth edition. 8vo, pp. 312, with 375 figures. New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1898. Price 15s.

Like other branches of science, mineralogy has for many years past been making rapid advances, and the work of acquiring the most recent information often entails the expenditure of much labour and time. On this account students of mineralogy will gladly welcome the appearance of this new edition of an already well-known book which it is unnecessary to praise. Suffice it to say that its past reputation is amply sustained in the present work. In it the most recent methods of blowpipe analysis are fully and clearly described. In chapter iii. the reactions of the elements are given in alphabetical order, and in the following chapter the various modes of procedure in blowpipe analysis are systematically set forth, the descriptions being accompanied by well-printed tables free from abbreviations.

Chapter v. is devoted to the physical properties of minerals, beginning with crystallography, which is dealt with in sixty-five pages. In this the now generally accepted treatment of symmetry is adopted, and the employment of crystal forms instead of spherical projections will probably enable the beginner to grasp this part of the subject more readily than he would do from the illustrations which have hitherto been used. The figures in this chapter are well executed. It might, however, have been indicated on p. 222 that a radiating fibrous or divergent crystalline structure is common to all the four minerals selected for illustration. The chapter concludes with a few pages on the different methods of determining specific gravity.

Chapter vi. consists of a most valuable series of tables for the determination of mineral species, thoroughly well brought up to date. These cannot fail to be of infinite use both to teachers and students. For the benefit of the latter the names of the most important species are printed in heavy type. A good index to general matter, followed by an index to mineral species, concludes this admirable and most useful book. F. R.

FERTILITY OF FARM AND GARDEN.

Fertilizers. By EDWARD B. VOORHEES, A.M. 8vo, pp. 335. London: Macmillan and Co., 1898. Price 4s. 6d.

The soils of America, like those of older countries, become exhausted in time by crop cultivation. We have increasing evidence of this in the multiplication of American works on fertilizers and the like. Of these the present

treatise is a good sample. While details applicable to the cultivation of sweet potatoes, millet, and cotton may be of little service to the British farmer or market-gardener, he will here find fresh light thrown on many matters of direct interest to him. The nature, uses, and value of staple artificial manures, as well as less familiar ones, such as "ground king crab" and "garbage tankage," are lucidly and popularly dealt with. We fully acknowledge that we have much to learn, and to unlearn also, in regard to the action of fertilizers. Experiments such as are being carried out at the American Experiment Stations are the surest means of affording the desired knowledge. We are again reminded of our need of similar institutions here.

JOHN H. WILSON.

Recent Advances in Astronomy. By ALFRED H. FISON, D.Sc. 237 pp. The Victorian Era Series. London: Blackie and Son, Limited, 1898. Price 2s. 6d.

To give in the scope of so small a book anything approaching an exhaustive account of the great achievements in astronomical science during the last sixty years would be far from possible. The author therefore confines himself to describing what are in his opinion some of the more important discoveries of recent times. It is at once evident that the greater part of the contents had thus to be devoted to a description of the splendid advances in spectroscopy, and in those fields of astronomical research which have thereby been opened to human thought. Here we find an instructive and interesting historical description of what has been done since the all-important invention of the spectroscope. One of the best chapters deals with the development of our knowledge of Mars, which, chiefly since Schiaparelli's discoveries, has become an object of earnest inquiry as well as of the keenest controversy. There is also an account of the investigations made with regard to stellar parallax, the distribution of stars in the heavens, their life in the past, and their probable future. Although allowance must be made for a difference of opinion as to whether the author has, on the whole, really selected what astronomers may think the most important advances made in astronomy during the Victorian Era, we cannot but admire the lucidity and grasp which he shows in his exposition of the subject. J. HALM.

The Educational Review is further entitled "A Magazine of the Science and Art of Education, and Review of current educational Literature and Events." It is henceforward to be published on the 8th of each month at 203 Strand, London, W.C., price 4d. A new series began with the January number. The object is to discuss the principles rather than the politics of pedagogy. The number sent us contains valuable and suggestive articles by Miss Beale, Canon Lyttelton, Dr. Sophie Bryant, and others, but nothing of special interest to scientific readers.

The Geological Survey of Queensland has issued as *Bulletin* No. 10, "Six Reports on the Geological Features of part of the District to be traversed by the proposed Transcontinental Railway," by R. L. Jack, Government Geologist. These were originally printed as a Parliamentary Paper in 1885, and are now reprinted with corrections and footnotes. *Bulletin* No. 9, also by Mr. Jack, is a "Report . . . on the Chillagoe Mining District and projected Railway." *Bulletin* No. 8 is a "Report on the Gold Mines at the Fanning and Mount Success (with map)," by W. H. Rands.

Dr. Gadow has been kind enough to point out an unfortunate mistake in our last number. "The Last Link" was said to cost 3s. 6d., whereas the price is 2s. 6d.

OBITUARIES.

HENRY ALLEYNE NICHOLSON, M.D., D.Sc., F.R.S., ETC.

BORN 1844; DIED JANUARY 19, 1899.

THE name of Henry Alleyne Nicholson has been so long familiar to successive generations of students of zoology and palaeontology, that it must have been a surprise to many to learn that his life had reached its close in only its fifty-fifth year.

His father, Dr. John Nicholson, was distinguished as a Biblical scholar, and was the son of a former President of Codrington College, Barbados. H. Alleyne Nicholson was born at Penrith on September 11, 1844, and received his school-training at Appleby Grammar School. He was also for a time in the hands of Francis Newman. He commenced the systematic study of natural science in the University of Göttingen, and from 1862 till 1867 he was a student of science and of medicine in the University of Edinburgh, graduating B.Sc. in 1866, and M.B. and C.M. in 1867. The study of medicine at that period offered the best access to the higher educational positions in natural science, and it was for this reason that he appears to have entered upon the study. In both science and medicine he was a most successful student, gaining high honours in the several classes. In 1866 he received the Baxter Scholarship as the most distinguished graduate in science for the year, and in 1869, on taking the degree of M.D., he was awarded the Ettles Medical Scholarship as entitled to the highest place for the year among the medical graduates of Edinburgh.

While yet a student he had turned his attention to the geology of his native district, and had studied it with such care that he received the gold medal for his doctorial thesis "On the Geology of Cumberland and Westmoreland." Devoting himself to natural science, Nicholson became, in 1869, Lecturer on Natural History in the Extra-mural Medical School in Edinburgh, and delivered courses of lectures in zoology and in geology during about two years. In 1871 he was offered, and accepted, the Professorship of Natural History in Toronto, in Canada. In 1874 he was appointed, almost at the same time, to the Chair of Comparative Anatomy and Zoology in the Royal College of Science, Dublin, and to that of Biology in the College of Science, Durham. He chose the latter, and performed its duties during two sessions. In 1875 he was offered the Chair of Natural History in the University of St. Andrews, and he held it until 1882, when he succeeded Professor Cossar Ewart in the Chair of Natural History in the University of Aberdeen. At that time the winter course in Aberdeen, attendance on which was compulsory for graduation in Arts, consisted of a hundred lectures, chiefly on zoology, the last two months or so being devoted to geology. The summer course, on zoology alone, was suited more especially for medical students.

In consequence of the changes rendered necessary in the curricula by the Ordinances of the Scottish Universities Commission, geology acquired a more

adequate status in the University of Aberdeen, being placed on an equality with the other natural sciences.

The teaching of geology now required provision for elementary and advanced work, both theoretical and practical, and Professor Nicholson applied himself with much zeal and success to securing the necessary equipment. The classes were greatly appreciated by the students, a fact that gave him much pleasure. He was relieved of the work of teaching zoology, except for the lectures in summer, his assistant, Dr. Alexander Brown, being appointed by the University Court lecturer in zoology, with the charge of the rest of the instruction in that department.

As a teacher Professor Nicholson was singularly successful. An adept in the sciences which he taught, he was not content to rest upon his stores of knowledge, but made it his practice to revise immediately beforehand the subject on which he was to speak. Possessed of natural fluency, and knowing clearly what he wished to communicate to his hearers, he secured their interest and admiration. He excelled as a draughtsman with chalks, and his lectures gained much by his free use of the blackboard. His success as a teacher was largely aided also by personal qualities, a keen but always kindly sense of humour and great geniality of temper, that won for him the love of his students and colleagues, and has made his death to be felt as that of a friend.

Dr. Nicholson was by preference a palaeontologist, and he did much original research in this field, the results of which have chiefly appeared in numerous lengthy and valuable contributions to the publications of scientific societies. Among these, which commenced with papers on Graptolites in 1866 and 1867, may be named particularly his "Monograph on the British Graptolitidae" (1872); "Reports on the Palaeontology of the Province of Ontario" (1874-75), published by the government of Ontario; "Monograph of the Silurian Fossils of Girvan, Ayrshire" (1878); "The Structure and Affinities of the Tabulate Corals of the Palaeozoic Period" (1879); and "Structure and Affinities of Monticulipora" (1881). As indicating the extent of his labours, we find in the Royal Society's "Catalogue of Scientific Papers" that up to 1883 he is named as sole author of seventy-five papers and as joint author of nineteen others. These numbers have since been considerably increased.

He was perhaps better known to students as the author of highly valued manuals and text-books on zoology and on palaeontology. The "Manual of Palaeontology," by Professor Nicholson and Dr. Lyddeker, reached its third edition in two large volumes in 1890, and has received very wide recognition. He also contributed zoological articles to the "Encyclopaedia Britannica," and was the author of a more popular work entitled "Natural History, its Rise and Progress in Britain."

In 1877, and again in 1890, he was appointed Swiney Lecturer in the British Museum, and in that capacity he delivered lectures on geology and palaeontology to large audiences with great acceptance.

During the past six years his health had not been good. Though not unfitted for the duties of his office he suffered from frequent attacks of influenza, with complications, which at the beginning of the present winter took the form of gastralgia. After a short period of severer illness he died on the 19th January.

He has left a widow, two daughters, and three sons. His sons have already gained distinction in their several paths. J. W. H. TRAIL.

WILLIAM COLENSO.

BORN, 1811; DIED, FEBRUARY 10, 1899.

THE Rev. William Colenso was born at Penzance. He started in life as a printer and bookbinder in the office of Watts and Son, London, where he was

engaged on work for the British and Foreign Bible Society. This early training stood him in good stead, for in 1833 he was sent out by the Church Missionary Society to establish a press in New Zealand. Here he spent his long life, devoted to missionary work mainly, and to botany, zoology, and ethnology secondarily. His first paper, on botany, was published in 1842 in the *Tasmanian Journal of Science*, and since that date he had contributed 32 papers on the above subjects to various periodicals. Colenso was an enthusiastic collector, and supplied Richard Owen with much information concerning the Moa and other extinct vertebrates. His knowledge of the Maori, his antiquities, and myths, was second to none.

THOMAS HINCKS, B.A., F.R.S.

BORN AT EXETER, JULY 15, 1818; DIED AT CLIFTON, JANUARY 25, 1899.

THE well-known author of "A History of the British Hydroid Zoophytes" (1868), "A History of the British Marine Polyzoa" (1880), and a long series of papers on marine zoology, most of which appeared in the *Annals and Magazine of Natural History*, was the son of the Rev. William Hincks, formerly professor of natural history at Toronto. From 1855-1869 he was minister of the Mill Hill (Unitarian) Chapel at Leeds, where he took an active part in public and philanthropic affairs, turning his leisure meanwhile to marvellously good account in zoological work, which is a model of painstaking accuracy and sound judgment. Failure of the voice compelled him to abandon his ministerial work, but he continued his scientific researches with zest almost to the end. At Taunton, and afterwards at Clifton, he lived his quiet life, gardening and observing and helping other workers. He was the last survivor of that illustrious company to which Professor M'Intosh recently referred (*Nat. Sci.* vol. xiv. p. 76) in his obituary notice of Allman.

The deaths are also announced of Professor DARESTE DE LA CHAVANNE, of Paris, the well-known teratologist; F. GAY, of Montpelier University, a student of the green algae, aged 40; GILBERT H. HICKS, First Assistant Botanist and Seed Expert of the United States Department of Agriculture since 1894, for many years an editor of the *Asa Gray Bulletin*—he left a work on seeds shortly to be published by the Macmillan Co.; Major J. HOTCHKISS, author of a number of papers on economic geology; Dr. FRANZ LANG, teacher of natural history at, and rector of, the Cantonal School at Soleure, Switzerland, aged 78; Professor GIANPAOLO VLACOVICH, anatomist, at Padua. The Aberdeen students' Magazine *Alma Mater*, for January 25, contains affectionate appreciations and a good portrait of the late Professor Alleyne Nicholson

CORRESPONDENCE.

Sir—Mr. Bulman's paper in your February number reopens a very interesting question. In the paper which he criticises, I contended (1) that nearly allied species are intersterile, and (2) that this being granted, we may put down to the credit of insects the development of flowers. To make good my first contention I depended mainly on the bees themselves; they not infrequently wander from species to species, and yet no intercrossing takes place. Thus I am able to dispense with the evidence supplied by the experiments of Alexis Jordan. If, however, his conclusions are accepted, my case becomes still stronger, since intersterility is extended even to sub-varieties. If it be conceded that species are sterile *inter se*, it is not difficult to show the reasonableness of my second contention. The plants compete for the visits of bees, and the bees are in the position of a gardener who isolates a particular species, selects his plants of brightest bloom, and sows seed only from them. This assumes that bees have a colour-sense. The experiments by which Prof. Plateau attempted to prove that they had none really proves nothing of the kind, as Sir John Lubbock made clear in the *Journal of the Linnaean Society* (April 1, 1898). It is true that scent may answer the same purpose as colour, but colour or fragrance a plant must have or else bees will leave it unvisited. As to the term by-product, I meant that the plants from which our phanerogams are descended produced colour, but turned it to no useful purpose. It has been fostered and developed through natural selection.

There remains a point which Mr. Bulman has raised and which I certainly dealt with inadequately. "Admitting," he says, "that all species, sub-species, and varieties, as they exist to-day, are sterile *inter se*, we cannot suppose that the *varying individuals* in a species—which must form the beginning of a new species—are so." In this almost all biologists will agree with him. It is impossible to accept the theory of physiological selection in the form in which Romanes propounded it. If a few individuals in a species, having no superiority to their fellows and no distinguishing mark, are fertile only *inter se*, they are not likely to leave descendants: with flowering plants, since in many species cross-fertilisation is required only occasionally, the chances are much better. The few "physiologically separate" individuals might, by means of self-fertilised ovules, so increase their numbers as no longer to be scattered units among the herd from which they have cut themselves off. Setting aside this possibility, we can appeal to geographical isolation to help us. Since individual plants are fixed in one spot, such isolation may easily arise and continue long enough for a variety, originated locally, to become sterile with other varieties or with the parent species. Such local forms might arise in neighbouring valleys or on the banks of two streams that flowed not far apart. Armed with the intersterility thus obtained our young species will extend their range and settle among allied species and varieties without danger of intercrossing, and the bees will be able to pursue the work of developing their flowers.

F. W. Headley.

Haileybury College, Hertford.

NEWS.

THE following appointments have recently been made:—Dr. Angelo Andres, well known for his work on sea-anemones, to be professor of zoology and comparative anatomy in the University of Parma; Dr. H. E. Annett, as demonstrator of tropical pathology in Liverpool; C. Gilbert Cullis, to be assistant professor in the Geological Department of the Royal College of Science; Dr. D. T. MacDougal, of the University of Minnesota, to be director of the laboratories of the New York Botanical Gardens; G. F. Stout, lecturer on comparative psychology at Aberdeen, to the recently founded Wilde lectureship in mental philosophy at Oxford; Vidal de la Blache to be professor of geography in the University of Paris; German Sims Woodhead, M.D. (Edin.), to be professor of pathology at Cambridge, in place of the late A. A. Kanthack.

Walter Myers, M.A., and E. S. St. B. Sladen, M.A., both of Gonville and Caius College, have been elected to John Lucas Walker studentships of the University of Cambridge; J. Stanley Gardiner, M.A., Fellow of the same college, has been elected Balfour student for three years from March 25, 1899.

Dr. Roux has been elected a member of the Paris Academy of Sciences in the section of rural economy.

Dr. Richard Garnett, C.B., keeper of the printed books in the British Museum, has resigned his position, after a connection with the institution of forty-eight years. His name will always be associated with the monumental catalogue which has placed the literary treasures of the Museum within the reach of all, and his personality will ever be remembered for unfailing courtesy and readiness to aid with his own almost unrivalled knowledge the humblest student who asked his assistance. There are many students of natural science who have had the advantage of his marvellous bibliographical erudition.

On February 2 a new bacteriological institute on a large scale was opened at Louvain.

The annual meeting of the Millport Marine Biological Association was held in Glasgow on February 9. The honorary treasurer, Mr. Alexander Somerville, submitted the annual report by the Committee of Management, which gave an account of the first year of the actual working of the marine biological station at Millport. There were over 8000 visitors to the museum during the past year, and tables in the laboratory were utilised for terms varying from a week to a month on thirty-eight different occasions. The Committee took this opportunity of tendering very hearty thanks to all who had contributed in any way to the welfare of the station. During the past year many additions have been made to the station, especially in the laboratory department, but much is still required. The station cost £1800, but the Association has paid its way, and the balance against it is at present only £153, which says much for the good management.

An experiment will shortly be made by a few interested in botany, towards establishing a collection of living British plants for purposes of study and

observation. The garden will be a small strip of land, 200 ft. × 80 ft., at Castlands Road, Perry Hill, London, S.E., and will be under the charge of Mr. P. Cochrane. According to the plan, which we have seen, the land will be laid out with soils suitable to special classes of plants, as clay, sand, chalk, etc., and there will be marshy tracts to suit on the one hand fresh-water plants, and on the other those that live near the sea. There will also be fresh and salt water pools. Small zoological and geological collections are proposed later. The idea is being pushed forward by Mr. W. H. Griffin, the Hon. Sec. of the Catford Natural History Society, Mr. A. A. Abbott of Perry Hill, and others. The main object of the promoters is to secure for their district an educational exhibit, which will be, should it prove successful, of considerable value, and in any case cannot fail to promote an interest in botany. Further particulars can be obtained of Mr. Cochrane, at 47 Perry Hill, S.E.

Dr. Melchior Treub, director of the botanical garden at Buitenzorg, recently celebrated the twenty-fifth anniversary of his doctorate. This has formed the excuse for the issue of a supplement to the *Annales* of that garden, which, in 167 pages with 9 plates, contains 23 papers written by some of the botanists and zoologists who have worked at the garden.

Cambridge University has bought the Carne collection of Cornish minerals for £475.

There has recently been erected at Great Crosby, near Liverpool, an erratic of gypsum, which was found in the boulder clay of that place. The erratic weighs about fourteen tons, and measures 9 ft. 6 in. × 7 ft. 4 in. × 5. ft. 7 in. The occurrence of gypsum is rare in these deposits, and Mr. Mellard Reade, who describes the specimen in a separately printed tract, is of the opinion that it probably came from Whitehaven, in Cumberland. The erratic was presented to the town by Mr. Edward Peters, and the District Council of Great Crosby have shown considerable public spirit in permanently preserving this interesting geological object lesson. The boulder has been erected in the precise position in which it was found.

Dr. E. J. Nolan has, says *Science*, presented the Philadelphia Academy of Natural Science with five volumes in memorial of the late Dr. Joseph Leidy. The first contains biographical notices and similar material; the second contains botanical drawings and notes by Dr. Leidy, and the remaining three his zoological drawings and notes. All are carefully indexed.

The latest of the Museum Handbooks (Publication 24) of the Manchester Museum, Owens College, is somewhat of an "omnibus" nature. It is devoted to "The Marine Mollusca of Madras and the immediate neighbourhood. Notes on a collection of marine shells from Lively Island, Falklands; and other papers. By J. C. Melville, M.A., F.L.S., and R. Standen." The "other papers" are really three short notes on individual species, and the whole, illustrating specimens in the museum, is reprinted, with the two plates, from the *Journal of Conchology*, vol. ix., "in the hope," which we cordially echo, "that they may prove useful to those who study the collections of Mollusca in the Manchester Museum."

This is not the first time that the museum authorities have drawn on the same Society for materials to form one of their excellent series of guides, and the principle is one which other kindred institutions would do well to copy, since publication by reprint must be an economical mode of publication. The original pagination has been scrupulously adhered to, as should always be the case in a reprint, but it spoils the look for a Handbook, and we would suggest to the museum authorities that appearances would be greatly improved if in future productions of this nature the original pagination were transferred to the inner end of each headline and an independent pagination inserted in its place. The cost would not be more than the finances of the College could well bear.

We have before now alluded to the educational collection of natural history specimens and literature relating thereto, belonging to Mr. S. Prout Newcombe, and at present displayed in the Free Library of St. George's, Hanover Square, London. The space is now required by the library commissioners for the regular purposes of the library. Mr. Newcombe now offers the collection to the London County Council under the following conditions:—(1) The collection is to be kept and exhibited always in a room to be named "The Natural History Reading Room," which room is to be maintained in good order at the expense of the Council, and the collection is to be kept separate and distinct from other than natural history objects and literature; (2) the collection is to be transferred to the Council for educational purposes, and not as a public exhibition; (3) before the end of the present year the collection is to be removed temporarily to the Shoreditch Technical Institute, and within a certain period thereafter to be transferred to a suitable place in the county of London. The "suitable place" may be the Chelsea Physic Garden, which, as we have already recorded, is to be made available for science students. The Technical Education Board has suggested the great hall of Aske's Schools, which would gradually be equipped as a museum in connection with the cabinetmaking classes. Whatever plan be finally decided on, we beg to urge that the exhibit should be made readily accessible to the wider circles of the public, for whom it is intended, and that no attempt should be made to give it a severely scientific or technical character.

Mr. Edward Austin of Boston, an East India merchant, has bequeathed 400,000 dollars to the Massachusetts Institute of Technology; and 500,000 dollars to Harvard College, Cambridge.

The *Scientific American* of February 4 reports on the results of the investigation of the late Mr. Keely's laboratory, which seem to show that the mysterious motor phenomena produced by "this nineteenth century thaumaturgist" were due to carefully concealed arrangements for the distribution of compressed air from a three-ton sphere beneath the building. Wonders do sometimes cease.

The 13th meeting of the "Anatomische Gesellschaft" will be held at Tübingen from May 21 to 24.

Professors Laguesse of Lille and Nicolas of Nancy have organised an "Association des anatomistes" analogous to the German Anatomische Gesellschaft. The first meeting was held in Paris in January.

The American Society of Naturalists has elected Professor G. W. Farlow of Harvard as its new president, and Professor T. H. Morgan of Bryn Mawr College as secretary.

The new president of the American Psychological Association is Professor John Dewey of Chicago.

An Anthropological Society has been started at Amsterdam. The president is Dr. C. Winckler; vice-president, Dr. E. Dubois; secretary, Dr. Sasse, fils; treasurer, Dr. C. Kerbert; librarian, Dr. J. E. Grevers.

At a meeting of the Scottish Microscopical Society, on February 17, Dr. Gregg Wilson read two short papers on *Ceratodus*. In the first it was shown that the lung arises in the two-months-old form as a mid-ventral diverticulum of the gut; in the second it was pointed out that the development of the pronephros bears a startlingly close resemblance to that of the newt.

On February 14, at the Royal College of Surgeons, Sir William MacCormac delivered the Hunterian Oration in the presence of the Prince of Wales, who is an honorary F.R.C.P., and a distinguished company. While recognising that Hunter was chiefly and finally a surgeon, he emphasised that his work was in the first instance biological. Our enjoyable contemporary *The Outlook* recalls a classic incident: "Interrupted one day in the midst of the dissection of a

rare and interesting specimen by the message that a patient was waiting in his consultation-room, he at first refused to see him. On second thoughts, however, he threw down his scalpel, and rising, with a weary sigh, exclaimed, 'But I suppose I must go and earn that d——d guinea!'—which is life in an epigram."

At a meeting of the Royal Physical Society of Edinburgh, on February 15, Mr. William Evans submitted a list of the Collembola and Thysanura of the Edinburgh district, drawn up by Mr. G. H. Carpenter, of Dublin, and himself. The list, which was based entirely on specimens collected by Mr. Evans during the past three years, dealt with forty-four species of Collembola and five of Thysanura. Six of the former were additions to the British list. Mr. J. G. Goodchild made a second communication on the genesis of some Scottish minerals, in the course of which he dealt with the changes which had been produced on minerals by the percolation of water from the surface downward. Mr. W. Eagle Clarke read a paper dealing with the recent appearance in Scotland of Macqueen's Bustard, and he also made a communication the subject of which was a Hebridean example of the Lesser Whitethroat.

The Egyptian Government, with the co-operation of the authorities of the British Museum, is about to begin a survey of the Nile, with the object of determining the species of fishes inhabiting its waters. The undertaking has been organised by Dr. John Anderson, F.R.S., who has long been zealously at work on the zoology of Egypt. His proposal for an investigation of the waters of the Nile from Cairo to its origin in Lake Albert met with strong support from Lord Lister, Professor Ray Lankester, and other distinguished men of science. It was also received favourably by Lord Cromer, with the result that the survey has been decided upon. The authorities of the British Museum have, it is understood, promised their assistance, and have also placed at the disposal of the Egyptian Government the services of Dr. Boulenger for the purpose of working out the material obtained by the survey. A number of places along the river are to be selected, at which collections will be brought together and placed in the Museum tanks, which, when full, will be dispatched to London. Mr. Leonard Loat has been appointed superintendent of the survey, and he will act under the direction of Dr Keatinge, chief of the Medical School of Cairo. Mr. Loat is leaving England in a few days to commence operations. The physical characteristics of the river and the river bed are to be carefully noted, and attention given to the habits of the fishes.

Mr. W. W. Skeat, of Cambridge, and formerly of Siam, has started, along with two zoologists and a botanist, on a scientific expedition to the southern regions of Siam, of which relatively little is known.

A report of the work done by the German Deep-Sea Expedition, up to the time of its arrival at Victoria, Cameroons, is given by Dr. G. Schott in the *Annalen der Hydrographie*, Heft 1, 1899.

Mr. John Whitehead has left for another scientific expedition to the Philippines. Mr. Whitehead's previous explorations were confined mainly to the island of Luzon. On this occasion he proposes to visit the southern islands, especially the great island of Mindanao, and should he succeed in penetrating into the mountains very valuable and interesting results are expected. If he is compelled to abandon his journey in Mindanao, he proposes to explore Formosa, Hainau, or the high mountains on the Siamese side of the Malay Peninsula.

Mr. P. G. Ignatof reports in *Globus* (lxxv. No. 3) that the salt lake of Kyzyl-Kak, in West Siberia, which is said not to freeze, has a bright red colour, due to the large number of small crustacea.

Mr. H. J. Elwes has recently returned from the Altai Mountains. One of his chief objects was to visit the head-waters of the Yenisei, almost unknown

even to the Russians—a great valley 300 miles wide by 200 miles long, scarcely inhabited, and practically unexplored. Mr. Elwes has brought home a large collection of butterflies and moths. On the high mountains of the south he secured three specimens of the famous wild sheep, one having a measurement of sixty-two inches round the curve of the horn. Several fine heads were also obtained of the great stag of the Altai. Mr. Elwes also made a good collection of plants from the valley, but unfortunately, owing to an accident when crossing a river, the greater part of that collection was lost.

Dr. Sven Hedin intends to make another journey in Central Asia. He will start from Kashgar, cross the Takla Makan desert by a new route, and pass through Tibet to India.

In the last number of *L'Anthropologie* (December 1898), Marcellin Boule abstracts the discussion on the plateau-flints of S.-E. England that appeared in our pages rather over a year ago. He sums up as follows :—"The problem of plateau-flints then is not elucidated. Perhaps this is because very different objects have been confused under a single name. Shapes like those figured by the English authors are found everywhere that flint exists, in all gravel pits, and even in our garden paths. As for those specimens, if such there be, that really do show the undeniable characters of intentional flaking, we must ask if the deposits whence they come are not analogous to those of our plateaux of the North of France, which are so rich and which differ from the valley deposits in their altitude alone." The defenders of plateau-man must try again.

A considerable area in South-Eastern Minnesota is coloured as Cretaceous on the official geological map. This is confessedly based on scattered masses, supposed to be inliers emerging from beneath a coating of drift. Dr. F. W. Sardeson, of the University of Minnesota, has recently examined these, and concludes that they themselves form a part of the north-western glacial drift, any Cretaceous fossils being *remaniés*. There is one possible exception, an area of half a square mile in Goodhue county; but even here the component strata are much disturbed, and the mass may be a huge erratic. Dr. Sardeson's results were published in the *Journal of Geology*, vol. vi. pp. 679-691, November 1898.

Falcon Island in the Pacific, near Tonga, has disappeared, after an existence of exactly thirteen years. H.M.S. "Penguin," which recently visited the spot, found that the island had sunk three fathoms below the surface of the water. It was created in the first instance by a volcanic upheaval, and another submarine eruption may replace it on the map. Between Auckland and Tonga the "Penguin" took deep sea soundings, attaining a depth of 4762 fathoms. This is said to constitute a record.

The Geological Society of Australasia has written to the Victorian Secretary for Mines, asking the co-operation of the Government in having a new geological map of Australia prepared as early as possible.

The Geological Museum, Brisbane, was recently robbed of some gold specimens and gems of considerable value. The articles were placed in a safe when the museum was closed, and the caretaker found that the wire connecting the alarm bells securing the glass cases had been cut and that the cases had been opened with keys.

The Queensland Government have appointed their geologist, Mr. Robert L. Jack, to supervise the collections of the exhibits to be sent from Queensland to the forthcoming Greater Britain Exhibition at Earl's Court and to represent the colony there. Mr. Jack reached London early in February.

Mr. L. Boutan makes a report (*Arch. zool. expér.* vi. p. 229), of which we have only seen the commencement, on the progress that has been made in instantaneous submarine photography since his memoir on the subject in 1893.

The following interesting bits of information concerning British New Guinea were given by Sir William Macgregor, the recent Administrator, to a representative of Reuter's Agency:—

"It is not a country in which a man can produce wheat or turnips. It is adapted above all things for growing rubber, and for tea, coffee, tobacco, and cotton. Cotton and tobacco are indigenous. The tobacco is of very fine quality and ought to prove a valuable export. Probably the two principal exports will be rubber and gold. There is a great field for rubber plantation, and there are several kinds of indigenous rubber of high quality. Cocoa-nuts grow luxuriantly all over the colony. Water transport is supplied by many rivers, and we have good anchorages and harbours along the coast-line. Railways are not likely to be very much required on account of our excellent waterways.

"The greater portion of the 400 Europeans in the place are engaged in mining, the remainder devoting their energies to general trading. The produce in which they deal is principally collected by the natives, and includes copra, sandalwood, pearls, and a number of other things. A considerable portion of the natives are employed in trading, and many are engaged by the European merchants.

"The natives are now quite settled over large areas of country, sufficiently so to make agricultural settlement under Europeans quite safe. In the remote districts there are, however, hundreds, and perhaps thousands, of tribes who have never seen or heard of Europeans. Since the great cannibal raid of two years ago, when all the war canoes were captured, cannibalism has been practically unknown in British New Guinea, although there may, of course, be an isolated case here and there.

"The prisons are the best schools for the natives. After the murder of Mr. Green, the magistrate, six natives more or less implicated in the affair were captured and put in prison. After a time they were made warders, and were subsequently given positions as constables among their own tribe, their first duty being to arrest the man who was chiefly responsible for the murder, whom we had previously been unable to find. As a result, the culprit was very soon brought in, and when I left all the ringleaders had been captured. This has been the general principle adopted by the Administration—in fact, it is the only possible one.

"The young people are left to the missions, who conduct their education, but the training of the grown-up people is, as I have pointed out, principally in the hands of the police and the gaols.

"The climate is much better than is generally supposed. During ten years I was only incapacitated from fever for about six days. This form of fever is very amenable to proper treatment, and proper treatment is simple. I believe that New Guinea will eventually be considered a healthy tropical colony. The average temperature for the year at Port Moresby is $82\frac{1}{2}$ deg., the highest reading recorded during four years being 97 deg., and the lowest 65 deg. At an altitude of 4000 ft. to 5000 ft. the climate is very agreeable. One very important fact is that we have no hurricanes."

In view of the extensive use of petroleum products for insecticidal purposes, it is interesting to note Mr. L. O. Howard's evidence (*Scientific American*, Feb. 4) that the maggots of a species of *Psilopa* seem to live comfortably in crude petroleum pools. They breathe by well-protected anal stigmata which are periodically protruded above the surface.

Dr. C. Viguier has invented a tow-net suited for rapid pelagic work, *e.g.* on board a steamship. The points of his invention are the extension of the filtering surface by plaiting the silk, the more rapid passage of water through the apparatus, and an increase of solidity. It is described and figured in the "Notes et Revue" of the *Arch. zool. expér.* vol. vi. pp. vi.-xi.